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VOL. XIV. NEW YORK, DEC. 7, 1889. No. 23

The Edison Patent in Canada. AN important decision was rendered last week in Canada, rehabilitating the Edison lamp patent in the Dominion, without appeal, and, therefore, giving a new turn to litigation in this country. The judges on appeal hold that Edison complied with the requirements of the Canadian patent law, and that his patent is, therefore, still valid. It is evident that this decision is one of importance, bringing nearer the actual determination of the Edison suits in this country.

Electrical Polemics. MR. EDISON'S recent article in the *North American Review* on the dangers of electric lighting has elicited a spirited reply from Mr. George Westinghouse, Jr., appearing in the current number. Mr. Westinghouse comes forward, not simply as the advocate of the alternating current, but also as that of the direct current of high tension. We give the pith of the article on another page, and cannot sum up the argument better than Mr. Westinghouse himself does in these words: "As has been the case with the utilization of all other forms of energy, the demand for the most economical methods will ultimately prevail, provided these can be made safe, as they most certainly can, by the exercise of proper precautions."

The Grand Jury's Opinion. AFTER hearing a large number of witnesses and experts as to the overhead wire question in New York City, the Grand Jury have made a presentment on the subject. It is likely to attract attention, for in many respects it vindicates the local lighting companies. In a word, the Grand Jury find the Board of Electrical Control to be negligent and incompetent and chiefly responsible for the present condition of affairs. They recommend that the Board be removed and the control of electric service and subways be "intrusted to competent supervision." We trust that legislation giving effect to these well-considered opinions of a picked body of intelligent citizens will shortly be carried through and put into effect.

Reconciling Rival Interests. A VERY pretty example of the manner in which rival electrical interests may be harmonized has been given recently out West, where a general district agent of the Westinghouse system has married the daughter of a gentleman whose territory marches with his own, and who represents the Edison interests. An event of this kind is not inaptly suggestive of the English feudal wars, when the father took one side of the quarrel and the son the other in order that the estates might be kept in the family. At any rate, we would commend the incident to the notice of other gallant general agents similarly situated, to whom the winning of a fair bride from the opposing camp may in itself be a triumph to be proud of for life.

Another Alleged Accident. A FEW days ago a sensational paragraph went the rounds to the effect that a boy at Chattanooga, while under one of the electric cars cleaning it, made contact accidentally with the current wires and was killed. As only 500 volts is used on electric roads, the story seemed apocryphal, but it "went." The true account of the accident now shows that no current was on at all at the time. The colored boy in question was under the cars wiping off the motors with waste. A groan was heard, and then some men at work in the shed found that the boy had fallen asleep, tipped his lamp over, and set fire to the waste and to his clothing. He died from the burns six weeks later. Nearly all the "electrical accidents" we have investigated have turned out to be of this nature, and we are becoming rather tired of exposing them.

Primary Battery Improvement. NO announcement of new work done by Mr. Edison causes very great surprise, especially since the erection and equipment of his new laboratory places at his disposal a wealth of apparatus and substances to work on. He has, therefore, delved into a variety of problems. Even the primary battery has not escaped his attention; in fact, he has been drawn to it by the necessity of providing a source of power for driving the machinery of some of his other inventions, such as the phonograph. After trying most of those used or suggested in the past, Mr. Edison has adopted a type of cell first brought to notice by Lalande and Chaperon some years ago, and with some modifications he has brought it into such shape that it is now claimed to be applicable to all work for which a battery can be used, whether on closed or on open circuit. The battery undoubtedly has some weighty advantages, though its E. M. F. is somewhat low, which, however, is counterbalanced by its low internal resistance.

Heating of Conductors. WE continue in this issue Mr. Kennelly's paper on the heating of conductors by the electric current, in which the author follows out the subject by ascertaining the extent and relation of the principal factors which make up the heat emitted by a wire. These are due to convection and radiation, and the relationship between the two is graphically shown in the curves. As pointed out, however, by Mr. Kennelly, these values only hold good for wires in the still air of a room, and are not broadly applicable to wires suspended outdoors and subject to the cooling action of the wind, in which case the wire may part with many times more heat by convection than in a quiet room. The investigation also shows that the current strengths required to elevate the temperature of wires to a given degree is greater in the case of blackened copper than with bright copper, amounting to a difference as high as 30 and more per cent. in the larger sizes of wires, and pointing to the obvious advantage of painting black all heavy wires freely suspended in central stations.

The Fire in Boston. BOSTON was devastated last week by a fire of serious proportions, and one of the first developments was an attempt to put the blame on the electric wires. No evidence that the wires caused the fire has yet been produced, but we are gravely informed that because one or two wires of the time system were burnt out suddenly, therefore the fire started in that way. It is just as reasonable to argue that the fire itself caused the time wires to break, and to cross other wires. Until more evidence is produced, it will certainly not be accepted as proven that the fire was of electric origin. It is, however, worth while remarking that the event gives signal proof of the value of the special form of conduit, to which we drew attention last week, for interior wiring. If wires, carried into a building, with fuses, were taken through such a tube, the fire danger would be brought down to the narrowest limitations, and it would no longer lie in the power of sensational reporters or irresponsible fire marshals to say, simply because it is an easy way out and fashionable, that an electric wire caused the trouble. We have ourselves seen experiments in the way of trying to start a fire in the tube that convince us of its great merits in this particular respect, as a safeguard that would not break down.

Hertz on Light and Electricity. IN an address delivered before the German Society of Naturalists, the national body corresponding to our Association for the Advancement of Science, the celebrated Dr. Hertz delivered an address on "The Relation between Light and Electricity," which is worthy of consideration, as it embodies his latest views on this subject. Starting with the fact that light is due to an undulatory motion of the ether, of which we know the wave length and speed, and that transverse waves are impossible in fluids, we are obliged to admit that the ether behaves like a solid body; but, on the other hand, taking into consideration the free motion of the planets, we encounter the difficulty that in this case the ether acts as a perfect fluid. Without attempting to explain away this apparent discrepancy, Dr. Hertz passes on to the consideration of the true nature of electricity and puts the question, now gaining more and more prominence: Is there such a *thing* as electricity? or, Are not all electrical phenomena connected with the properties of the ether and ponderable matter? To which he answers that the state of our knowledge does not yet allow us to answer this question in the affirmative. Dr. Hertz then traces the history of the theories thus far advanced to account for electrical phenomena, from the old double-fluid theory, which finally succumbed, under the clear reasoning of Faraday and his confirmatory experiments. But Faraday, though early recognizing that there must be some relation between electricity, magnetism and light, failed to establish the great fact that the velocity of light is practically identical with the velocity representing the ratio of the electro-static to the electro-magnetic unit of quantity, which would at once have placed his theory on a solid foundation, although other collateral evidence was not wanting. But it remained for Maxwell to give this theory a firm basis by his masterly mathematical treatment of the subject. The factors which constitute the basis of this theory are these: Electricity in movement produces magnetic forces; magnetism in movement produces electric forces, and these effects are only appreciable at great velocities. Hence the idea of velocity enters into the relation which connects electricity and magnetism, and the constant which determines this relation has been found over and over again to be the same as the velocity of light. The demonstration of the possibility of obtaining light directly from electric or magnetic effects would have been a striking confirmation of the theory, but was not effected, and it remained for Dr. Hertz to confirm Maxwell's theory by proving the existence of electric or magnetic undulations propagating themselves in a manner similar to luminous undulations. But how was this to be demonstrated accurately? was the first question which the investigator asked himself. After discussing various methods the well-known oscillatory character of the Leyden jar discharge was seized upon as a basis for the investigation, in which a single vibration might be chosen as a sort of unit. But the Leyden jar discharge, short as it is, was found to be too long, a single vibration of the shortest character being propagated to a distance of 300 metres during its existence of about one millionth of a second. But the discovery that oscillations were induced in neighboring conductors by the discharge of the jar at once placed in the hands of the investigator an apparatus which would give far more rapid oscillations than that of the jar itself, being of the frequency of 100 to 1,000 million per second, and which could be made to give wave lengths of 10 metres. With such a conductor and a "finder" consisting of rectilinear metallic wire with a slight break, through which the induced spark jumped, the electric field could be thoroughly explored and the nodes of the electric waves located with accuracy. And now came the crucial test of the accepted theory: Were the waves longitudinal or transverse? To find the answer the wire was placed in two different positions at the same spot. In the one it showed electric excitation; in the other it did not. This decided the question: the waves were transverse. Again, What was the speed of propagation? It was only necessary to multiply the wave length by the duration of the vibration, which could be calculated, and the result proved to be a velocity approximating that of light. Here, then, the theory of "action at a distance" must meet its final overthrow, if, indeed, it still has any supporters among modern scientists. But, on the other hand, it places on a firm basis the theory of Maxwell, which, grounded on a few facts, was, by his powerful mathematical analysis, made to embrace the whole science under one comprehensive theory. Thanks to the wonderful facts brought to light recently, we may now study electric effects in the same way as we study optical ones. Thus we can refract the electric wave and bring it to a focus; we can reflect it in any desired direction, polarize it, etc. With all these facts before us, Dr. Hertz remarks that in the future we must not speak of currents traversing conductors; we must speak only of undulations crossing space, separating from, or re-enforcing each other. On the other hand, the domain of optics is no longer limited to undulations only a fraction of a millimetre in length; we have now to deal with waves whose length may be measured in decimetres, metres and kilometres. From now on electric action will be detected in many places where it was not previously suspected, and, we may add, that a good foundation has been laid for the direct conversion of electricity into light without the present wasteful accompaniment of heat.

NEW BOOKS.

THE AMERICAN RAILWAY. Charles Scribner's Sons, New York, 1889. Half leather, octavo, 225 illustrations, etc. 456 pages. Price, $6.

This work is a reprint of the various articles that have appeared in *Scribner's Magazine* recently from a number of authorities. It is a most interesting, amusing and instructive account of the railway industry in all its departments, and lacks nothing that could serve as a record of the perfection reached by railroads in America in the present

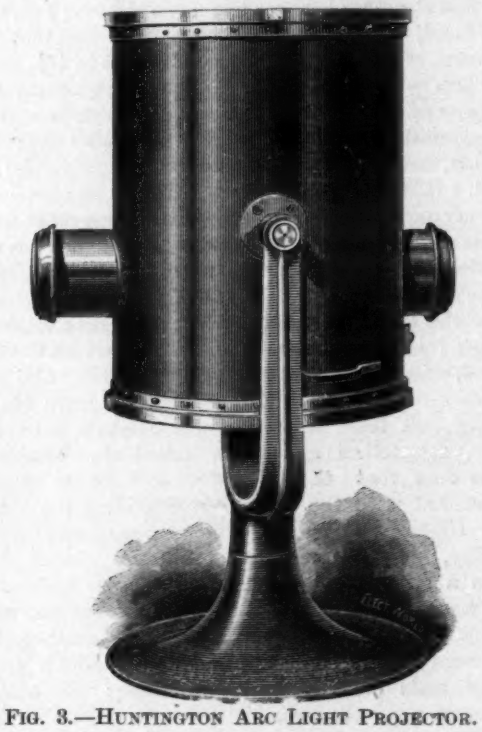


FIG. 3.—HUNTINGTON ARC LIGHT PROJECTOR.

year of grace. In fact, the volume shows that while much remains to be done in the improvement of railroads, the methods and principles now known have pretty well yielded all their best results, and that there will soon be a new point of departure. The stage coach had reached a high degree of beauty and usefulness just at the time the steam railway came into existence, and now we have exhibited here the steam road equally advanced just at the moment when the electric road is so rapidly developing and offering so many advantages over steam. It is incumbent on every one interested in questions of land travel to make himself familiar with the many problems involved in the subject, and here is a ready means of mastering details and intricacies that are commonly within the understanding of experts only. We would especially recommend this beautiful volume to electricians, as they will find it full of suggestions and new ideas or sound principles skilfully presented.

EXPERIMENTAL SCIENCE. By G. M. Hopkins. Munn & Co., New York, 1890. Large octavo. 600 illustrations. 740 pages. Price, $4.

Mr. Hopkins has produced a most interesting volume. We can readily imagine the delight with which any boy of a scientific turn of mind will study its pages and repeat the novel experiments described and illustrated. Scientific text-books for the young are apt to take on an unattractive and even repellant shape, but this is one whose every page is an invitation to the joys of physical investigations. And the book is one, too, that will charm a great many persons far beyond childhood. There are not many general readers who care to bother with abtruse science after the educational period of youth; but the man must be dull, indeed, to the scientific and inventive progress of the age who cannot derive genuine pleasure and benefit from a perusal of these well-written and informational pages, which put the student fairly abreast of the latest achievements in modern physics. The electrical chapters of the book are notably good, and the practical instructions given for building simple electrical machinery may be safely carried out by those, not a few, who like to make their own apparatus.

The Huntington Arc-Light Projector.

At the Maritime Conference now being held in Washington the attention of the delegates has been drawn to a marine projector in which several novel features have been introduced to effect the parallelism and concentration of the beam. The manner in which this has been effected will be understood from the accompanying diagrams, Figs. 1 and 2, which represent respectively a horizontal and vertical section of the parabolic reflector. As will be seen, a pair of lenses *L L* is fixed concentrically in the parabolic reflector, and at such a point in its optical axis as to place the arc in the combined focus of the lenses; and as the arc is also in the focus of the parabolic reflector, the result obtained is, that light radiated from the point *F* is refracted by the combination of lenses and reflected by the parabolic reflecting surface into a sheaf of parallel rays, as shown by the dotted lines *A B C D E*. The black lines *G H* proceeding from the position of the arc *F* to a point inside the mouth of the reflector and the edge of the interior lens show that the focal length of the lens combination is so computed that, while the arc *F* is in its focus, it occupies a position that prevents the escape of any of the radiating light which otherwise would escape as diverging light out of the mouth of the reflector. It will also be noticed that the extreme width of the cell containing the lenses is the same as the back opening, *O*, of the parabolic reflector; consequently it intercepts none of the reflected light, as shown by the dotted lines *J* and *K*.

It will be seen that, were the parabolic reflector intact, having a refracting surface back as well as forward of the flame, all rays of light falling upon the portion back of the flame would be reflected thence in lines parallel or otherwise, according to the degree of curve of the reflector; but on entering the lens would be refracted thereby, and would issue from the reflector with an angle of divergence proportionate to the curvature of the lens. To avoid this difficulty and utilize the backward as well as the forward rays of light as part of the beam of light cast by the reflector is the object of the present arrangement. To this end a section of the back of the reflector of a diameter equal to that of the outer lens *L* is removed, and to intercept and cast back the rays of light passing through the aperture thus formed a hemispherical reflector *N* is employed, which is hinged on to the parabolic reflector at the point *P*, the curved dotted line *S* representing its swing upon the hinge. This spherical reflector is made wider in diameter than the back opening of the parabolic reflector, in order to leave an open annular space *T T* between them, for the purpose of obtaining a free circulation of air.

Another of the objects of this mode of construction is to obtain greater distance from the luminous point for the metallic reflecting surfaces, so that their heating may be reduced to a minimum.

The main object of this arrangement, however, will be apparent by an inspection of Fig. 2. It will be noticed that the geometrical centre of the cap *N* is arranged slightly in advance of the illuminating point *F*. Thus the rays represented by dotted lines 1 2 3 radiated from the arc *F*, after impinging on the surface *N* of the hemispherical reflector, are reflected through the optical axis *V* at some distance in front of the light, in order to avoid their interception by a lamp or carbon point. Two of those rays are shown falling upon the lenses *L L*, and one upon the reflector *R*, and their continuation, shown by the arrow-headed, dotted lines, shows their small amount of divergence from coincidence in direction with the rays shown in Fig. 1.

The combination of two lenses, as shown in both figures, is thus a necessity, because the focus required is so short that a single lens to obtain it would have to be double convex, and a large portion of the radiated light would impinge upon the inner convex surface at angles greater than that of total reflection, and, therefore, would not pass through the lens, but would be reflected from its inner surface, scattered and lost.

The projector is shown complete in Fig. 4 in position when used as a search light. It is perfectly hooded at the back and sides so as to remove all glare from the eyes of the pilot. The illustration, Fig. 3, shows it in position for signaling in thick or foggy weather. The light is then

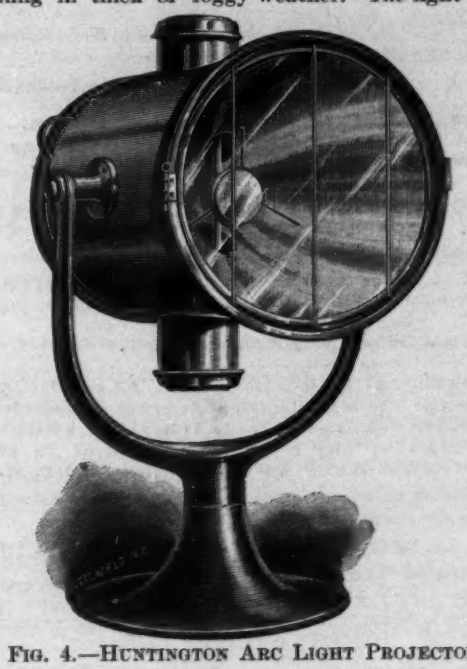
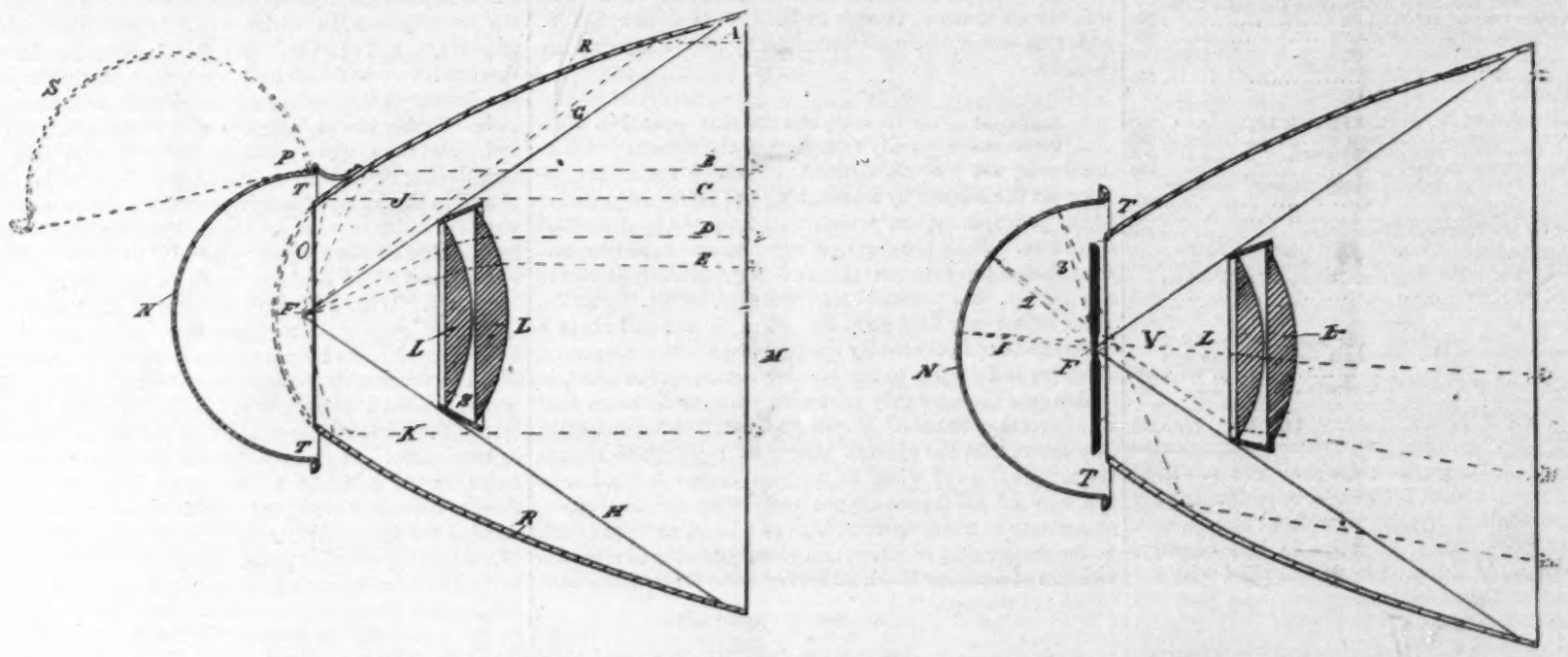


FIG. 4.—HUNTINGTON ARC LIGHT PROJECTOR.

thrown upward as a vertical beam, which can be seen a long distance and locates the vessel carrying it. The projectors combined, one with the beam colored green and the other red, can be thrown upward at an angle and by their intersection give the exact location of a vessel.

The arc lamp within the projector operates in any position, and the beam can be arranged to be flashed in conjunction with the whistle or other sound signal.

This projector is manufactured by the Scott Electrical Works of this city, and a number of them have for some time been in operation upon the steamers "Rhode Island" and "Massachusetts" of the Providence and Stonington line. The current is supplied from the regular incandescent light circuits on board these ships, and the officers of the vessels express themselves in high terms of their value.



FIGS. 1 AND 2.—HORIZONTAL AND VERTICAL SECTION OF PARABOLIC ARC PROJECTOR.

Arc Lights in Vacuo.

To the Editors of The Electrical World:

Will you kindly answer the following questions?

1. Will an arc light burn in a vacuum? 2. Will the carbon be consumed to any great extent? 3. If so, why are not such lamps used?

By answering the above you will greatly oblige a reader of your paper since its first publication. VACUUM.

BOONTON, N. J.

ANSWER.—1. Yes. For a long time after the discovery of the arc light by Davy, the charcoal pencils employed were placed within a globe exhausted of air. 2. Carbons placed in vacuo, though not consumed by combustion, nevertheless waste away by vaporization and by disintegration due to the intense heat. The action of the current also carries particles from the positive to the negative carbon point, hence it is gradually wasted away. 3. For the reasons given above, vacuum arc lamps cannot be successfully employed.—EDS. E. W.

Electric Lighting at Milan, Italy.

One of the most interesting central stations in Europe is that at Milan, Italy, where a large plant of Edison incandescents and Thomson-Houston arcs has now been operated successfully for some years. The plans of the station have already been illustrated in our pages. A special feature of the installation is the running underground of the arc wires as well as the incandescent. We illustrate on this page one of the principal thoroughfares of the city, where the arc lights are placed centrally in the roadway, the wires leading to them underground. The results obtained have been very satisfactory, and it is said that the lighting effect is extremely fine.

Mr. George Westinghouse, Jr., on Safe Electric Lighting.

In the December number of the *North American Review*, Mr. George Westinghouse, Jr. has a reply to the article by Mr. Edison that appeared in the November issue on the dangers of electric lighting, in which Mr. Edison took his stand in favor of the low-tension direct current, held also that high-tension currents could not be operated safely and successfully underground, and declared himself in favor of the absolute prohibition of alternating currents. Mr. Westinghouse now contends that Mr. Edison's views may be referred back to commercial considerations, and to the fact that the various shortcomings of the direct low-tension system have become so evident that it now bids fair to be "wholly supplanted by the more scientific and in all respects, so far as concerns the users or occupants of buildings, far safer inductive system." Mr. Westinghouse continues as follows:

"Accepting Mr. Edison's classification of the currents used for electric lighting, let us discuss them as follows:

"'*First*—The low-tension continuous current, with a pressure not exceeding 200 volts, used for incandescent lighting.

"'*Second*—The high-tension continuous current, with a pressure of 2,000 volts and over.

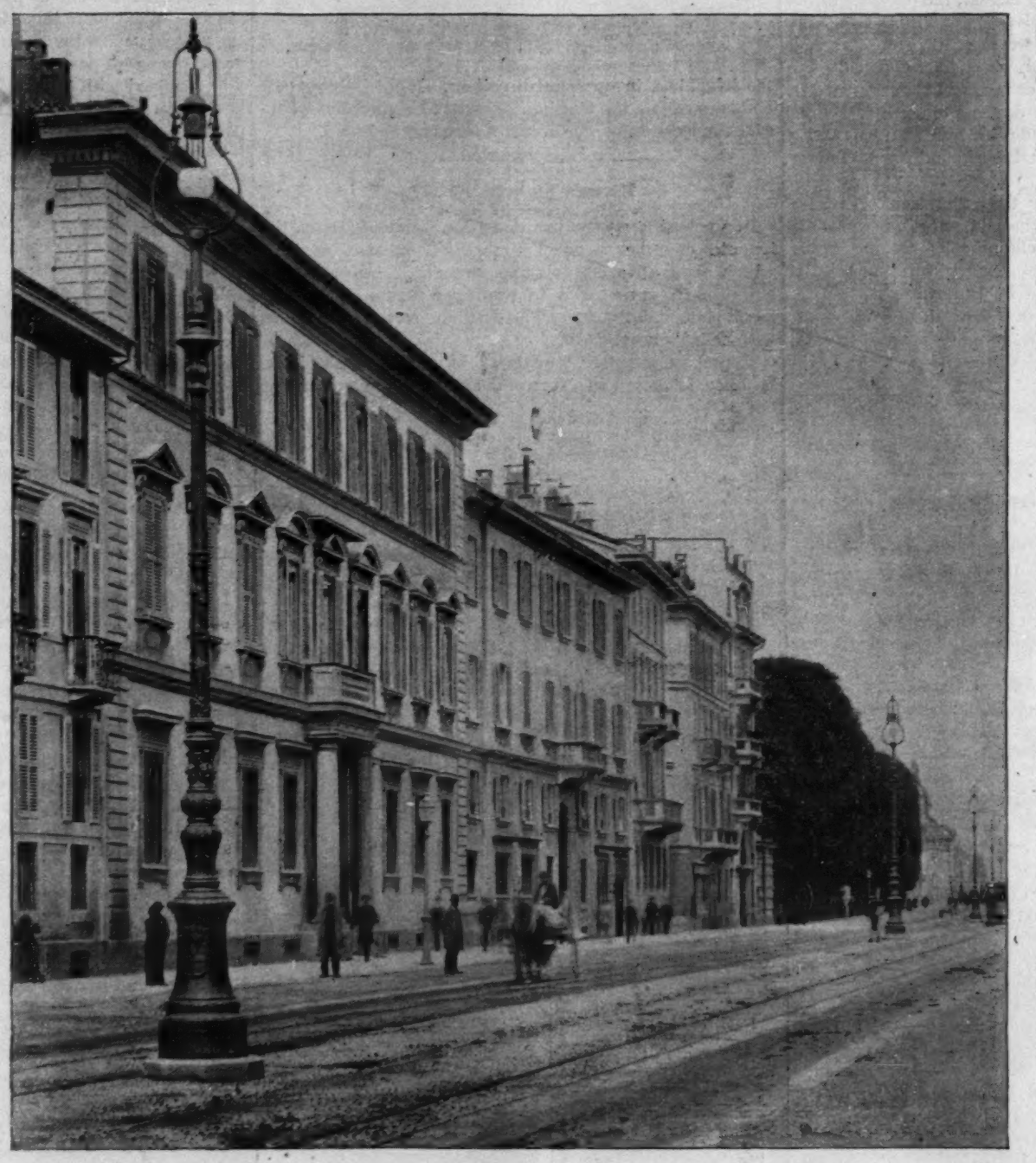
"'*Third*—The high-tension semi-continuous, or pulsatory, current, with a pressure of 2,000 volts and over.

"'*Fourth*—The alternating current, with a pressure of from 1,000 to 3,000 volts and over.'"

"The first is not dangerous when a person comes into momentary contact with one wire, but no one can endure its passage through the body when the contact is made "in the most effective manner." I have witnessed the roasting of a large piece of fresh beef by a direct continuous current of less than one hundred volts within two minutes. Any one having access to electric lights operated by the low-tension underground system in New York can easily prove to his own satisfaction how much credence ought to be given to the assertion that a current of 200 volts can be passed through the human body without producing uncomfortable sensations. Let him connect a tin pan to one of the electric wires, and place therein a thick piece of beef, and upon this a gridiron of metal connected to the other wire. The electrical energy exhibited in the steaming and cooking of this beef may possibly surprise the experimenter. If the current is from an underground main, the experiment may be varied by connecting the gridiron to a water-pipe with like results. With even less than one hundred volts it is painful beyond endurance to press firmly with the hands the brushes or any bright brass-work of the dynamo, or to grasp any metal connected with the wires.

"That a continuous current of moderate tension may produce death when the connection is continued for even a short time is shown by the published record of experiments conducted by Mr. A. E. Kennelly at the Edison Laboratory. With a continuous current of 400 volts a dog weighing fifty-seven and a half pounds was killed in forty seconds; and in another instance, with 1,000 volts of continuous current, a dog weighing thirteen and a half pounds was killed instantly. That an alternating current of one hundred volts, even when effectively applied, does not kill is shown by two experiments on another dog. A continuous current of 304 volts was applied for thirty seconds, and then an alternating current of one hundred volts for sixty-five seconds; yet the dog was unhurt. But mark this important fact: The so-called "alternating current" used for these experiments on animals was not the alternating current of commerce, but was an Edison direct continuous current made alternating by a "pole-changer," producing an effect incomparably more dangerous than the true alternating current under discussion, because of the exaggerated tension resulting from the partial discharge of the field magnets of the dynamo, which act in this case like a Ruhmkorff coil of enormous dimensions.

"The power of destruction residing in the low-tension current under certain conditions is best illustrated by quoting from Mr. Edison's own article, where he says: 'Near the corner of William and Wall streets, New York, the underground conductors of the Edison Illuminating Company became crossed, and the current which was passing through them at a pressure of only one hundred and ten volts melted not only the wires, but several feet of iron tubing in which they were incased, and reduced the paving stones within a radius of three or four feet to a molten mass.' He adds: 'This system is so arranged that consumers are not affected by such accidents as these.' But it is, nevertheless, true that every consumer is directly connected to the mains, so that it is evident that the reverse of this statement would have more truly represented the actual possibilities of the case."



STREET IN MILAN, ITALY, WITH ARC LIGHTS IN THE CENTRE.

Mr. Westinghouse then goes on to argue for the greater safety of the alternating incandescent system, which "has an enormous advantage" in the fact that the consumer is not brought into direct contact with the main supply; and he points out how really few are the deaths from electricity, even where poor methods of insulation have been resorted to, as compared with other agencies of power and light in common every-day use. As to underground high-tension wires, Mr. Westinghouse instances a number of cities where they are in successful operation, including the Milan plant, an illustration in connection with which appears on this page. He says:

"As to the accidents from electric currents, the records of deaths in the city of New York show that there were killed by street-cars during the year 1888, 64 persons; by omnibuses and wagons, 55, and by illuminating gas, 23, making the number killed by the electric current (5) insignificant compared with the deaths of individuals from any of the other causes named. The placing of the wires underground would eliminate many of the causes of accidents from electric currents, and they may all be prevented by the employment of reasonable and well-understood safeguards. Mr. Edison's statement that the putting of the wires underground will, instead of diminishing, increase the danger to life, is little less than amazing, at least when considered in connection with his advocacy of his own underground system. The repeated and violent explosions of gas in the man-holes of the Edison system, and in connection with the underground systems of the telephone and telegraph companies, have certainly shown that electricity from any source, either from low-tension electric-light, telephone, or telegraph currents, either of which is capable of producing a spark, may be the cause of a serious catastrophe, although there is no doubt that the accumulation of explosive mixtures within these chambers can be effectually prevented. Inasmuch as Mr. Edison's arguments against underground wires generally are equally applicable to his own system, it would seem, logically, that, if his views are to prevail, all electric wires must cease to serve the public. The experience of the cities of Chicago and Philadelphia in the use of underground cables for high-tension currents, to say nothing of the large number of cables laid underground in Rome, Berlin, Milan, and in other cities, indicates that the success of properly constructed underground systems whether for currents of high or low tension, has been established beyond question."

Mr. Westinghouse closes his article thus:

"A careful consideration of the whole subject proves that it is possible to light all the buildings within a city by means of electricity distributed by an underground system, wherein there shall be no connection whatever between the underground system and the wires within the buildings. It has been demonstrated that an incandescent lamp operated by a 50-volt current will give more light at a given cost than a 110-volt lamp; and these two things being admitted, it follows that if there are to be any restrictive regulations with reference to electric lighting, they might more properly be: *First*—That the electromotive force within any building shall never exceed one hundred volts; *Second*—That no underground system shall be placed in electrical connection with the wires in the building; *Third*—That no underground system shall be permitted which does not provide for the renewal and repair of the mains without digging up the streets.

"In conclusion it is worthy of note that for three years past the purchasers of apparatus for electric lighting, who are at perfect liberty to buy from any company, have, for the most part, preferred to use the alternating system, so that to-day the extension of that system for central station incandescent lighting is at least five times as great as that of the direct current. If the opinion of these persons, who can have no interest except to purchase that which they believe to be the best, is of any value, then the alternating system has been demonstrated to be the one which can give to the public that which they so much desire—a safe, cheap, efficient and universally applicable system of incandescent electric lighting."

Polarized Electric Roads.

To the Editors of The Electrical World:

I have been told that street railroads operated by electrical power have been found not to work as efficiently when running north and south as when running east and west. Can you tell me if this is anything more than a superstition, or if it is a well ascertained fact? P.

NEW YORK CITY.

[ANSWER.—Such a phenomenon has never been brought to our notice, and it exists only in somebody's imagination. There is no more difference between electric roads rnnning east and west and those running north and south than there is between a north-seeking mule and a south-seeking one.—EDS. E. W.]

The Edison Patent Sustained in Canada.

The Minister of Agriculture of the Dominion of Canada has just rendered a decision dismissing the petition of the Royal Electric Company, of Montreal, for the cancellation of Edison's patent on the incandescent lamp owned by the Edison Electric Light Company and originally granted to Thomas A. Edison.

It will be remembered that Richard Pope, Deputy Commissioner of Patents, rendered his decision in this same petition on Feb. 26 last, in which he annulled the Edison patent by virtue of section 37 of the Patent Act. A doubt having arisen as to the jurisdiction of Mr. Pope, it was decided that the case should be commenced *de novo*. A rehearing accordingly took place before the Hon. John Carling, Minister of Agriculture, on July 23 last, Sir John Thompson, Minister of Justice, sitting with him.

Some of the courts in this country have laid down the far-reaching principle that when a foreign patent (granted prior to the date of the same patent in the United States) expires, the United States patent, *ipso facto*, becomes null and void. Under this interpretation of the statute the annulling of the Canadian patent would have terminated the life of Edison's patent in this country.

The following are the essential features of the Hon. Mr. Carling's decision:

(1) I find that Thomas Alva Edison, the patentee of the patent in the proceedings mentioned, did within two years from the date of such patent commence, and after such commencement did continuously carry on in Canada the construction and manufacture of the invention, patented in such manner that any person desiring to use it might obtain it, or cause it to be made for him at a reasonable price at some manufactory or establishment for making or constructing it in Canada.

(2) I further find that after the expiration of twelve months from the granting of the said patent, neither the said patentee, nor any person claiming or holding under him, did import or cause to be imported into Canada the invention for which the said patent was granted.

I do, therefore, in pursuance of the statute in that behalf, declare that the said patent has not become null or void, and I dismiss the application of the petitioners, the Royal Electric Company of Canada.

Under the Canadian statute there is no appeal from this decision.

The Moennich Induction Telemeter.

The registration of temperature, barometric pressure, height of water, etc., from a distance, has given rise to a variety of forms of apparatus known as telemeters, whose use is constantly increasing. In the instruments generally employed at present the indications are maintained by current impulses, which are sent over the line when a change occurs in the conditions it is desired to register. An interesting departure from this method has been recently effected by Herr Paul Moennich, of Gehlsdorf, Germany, in which the induction between two coils is made the medium of registration at a distance.

The manner in which this is effected will be readily understood from the accompanying diagram, which represents the apparatus installed at the two stations.

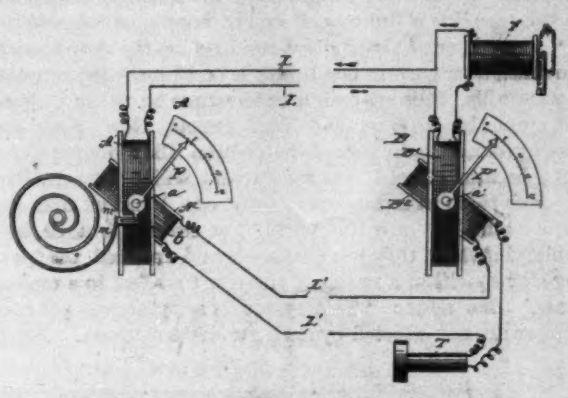
At station A, where the measuring instrument m, such as a metal thermometer, is set up, and the indications of which are to be transmitted to a distant place B by means of electricity, there are two wire coils A' and A^2. The larger coil A' is stationary, whereas the smaller coil A^2 is made to revolve easily inside the larger coil A' and a round axle a. The pointer p of the measuring instrument is connected with the axle of the coil A^2, so that it transmits its revolving motion to the coil A^2. The movements or variations of the measuring instrument m are transmitted to the coil A^2 through the shaft a of the coil and the short arm b of the pointer lever p. The connection between the instrument m and the short arm of the lever consists of a pin entering a slot in the plate m'. In this way the instrument exercises by means of a lever such a rotating effect on coil A^2 that the different positions of coil A^2 to coil A' answer to the different indications of the pointer p.

Any position of the two coils relatively to each other and the corresponding indication of the measuring instrument can be ascertained and determined at the observation station B in the following way: At station B there is a system of coils similar to those at station A. The stationary coil is marked B' and the revolving coil B^2. The indicator p' is firmly connected with the shaft a' of the coil B^2.

The stationary larger coils A' B' are connected with each other by a conductor L, to which an induction coil is applied at F. This induction coil sends currents in quick succession through the wire L and through the coils A' B', connected with the latter. The secondary coils A^2 B^2 are likewise connected with each other by a closed conductor L', to which a telephone T is applied at station B. The primary currents in A' B' and wire L produce induced secondary currents in the revolving coils A^2 B^2. The strength of these induced currents depends materially on the position of the secondary coils A^2 B^2 relatively to the large primary coils A' B'; but in all cases in which the two secondary coils occupy the same relative positions to the primary coils the two induced currents will have the same intensity.

At any time he relative position of the wire coils of station A to each other can be ascertained at station B by turning coil B^2 round the axis a' until equality of the two inducing currents has been produced. The indicator p' then points to a place on the scale which answers to the equivalent position of the pointer p of the measuring instrument at station A.

A telephone T serves to indicate the relative intensity of the induced currents. The currents of the two secondary coils A^2 B^2 are for this purpose conducted through the



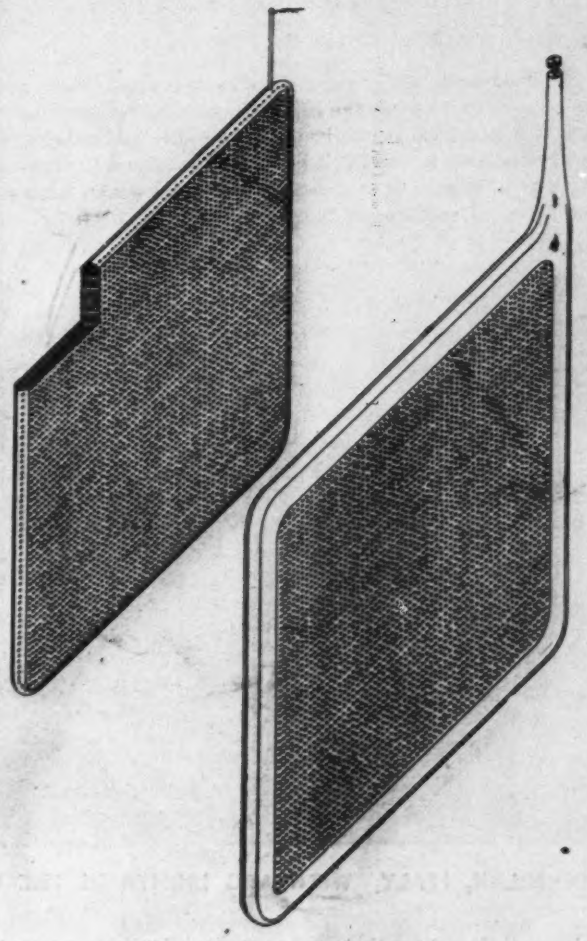
THE MOENNICH INDUCTION TELEMETER.

the telephone in opposite directions. If the induced currents are equal, the telephone ceases to sound; but whenever the least difference occurs a tone can be heard.

Payen's Storage Battery.

In a patent recently issued to Mr. Clément Payen, the inventor describes a novel method of preparing a plate which shall have considerable strength. The principal object of the inventor is to produce a porous crystallized metal plate with the crystalline structure formed in columns with cells between them.

To prepare the plate, a quantity of chloride of lead, for instance, is melted in a furnace, and a certain quantity of



PAYEN'S STORAGE BATTERY.

asbestos, or analogous material, is combined with it. When the mass has been thoroughly fused and mixed, it is discharged in a mold, in which it crystallizes on cooling. Mr. Payen points out that care must be taken in the selection of the material of which the mold is made, and the interior surface should be perfectly smooth. For this purpose Mr. Payen prefers a mold of brass or bronze composed of two symmetrical sections hinged together.

The plates formed in this manner are then mounted together with lead plates into a cell, the system of crystallized chloride plates being connected to the negative pole of the dynamo. In the ensuing electrolytic action which takes place, the oxygen and chlorine are separated and caused to attack the system of lead plates, while the crystallized plates are reduced to a metallic state with the asbestos included as a binding material, which gives strength to the whole. The accompanying illustration, Fig. 1, shows the plate as cast in the mold, and Fig. 2 after the addition of a supporting frame cast around it.

Porous Cups in Batteries.

To the Editors of The Electrical World:

1. Please kindly state if paraffined porous cups can be used for a blue vitriol battery jar, and for how long. 2. Could prepared lead plates, as in a Planté accumulator, be crushed to powder and used as elements in a porous cup battery to avoid short circuits by disintegrating?

RICHMOND, Ind. E. K. G.

ANSWER: Slightly paraffined porous cups have been used to prevent a too rapid local action, but the practice is not be recommended. A better plan is to obtain a porous cup of the proper porosity. 2. If proper metallic contact with the external circuit can be obtained throughout the crushed mass, this arrangement would probably operate satisfactorily, though the porous cups would introduce appreciable internal resistance in the battery.—EDS. E. W.

The Obtaining of Continuous from Alternating Currents without Using a Commutator.

To the Editors of The Electrical World:

The writer has noticed that much of your valuable space has been taken up with discussions or descriptions of so-called methods of "Obtaining Continuous from Alternating Currents without Mechanical Commutators." In the descriptions thus far given no data or reference to actual results obtained in the practice of any of the devices for this purpose seem to be given; in fact, they are conspicuously absent. What more important invention could we have at the present, when the alternating system is so universal, and the want of powerful motors and other advantages now obtained with continuous current so urgent? Certainly such an invention ought to be developed at the earliest possible moment.

The statement of Mr. Ries that he has "applied the principle in the designing of self-exciting alternating current generators and motors, etc.," leads one to expect that some or all of the numerous and valuable devices have been tried in practice. Certainly we would hardly expect one to spend valuable time in making elaborate designs on paper unless such designs were for the purpose of assisting in the construction of some useful devices. This matter being of such interest and importance, the writer, no doubt speaking for other readers of THE ELECTRICAL WORLD, would like to learn of some actual results in this line, as well as upon what peculiar electromotive or electro-magnetic force such results were made possible. W. J. M.

Electric Shocks Again.

To the Editors of The Electrical World:

In your issue of Nov. 23, the article on "Electric Shocks," by Dr. Vander Weyde, seems a little misleading in some of its particulars.

If the man spoken of simply touched the terminals of an arc lamp in circuit with forty-three others, he forms part of a divided circuit and does not get a deadly shock unless grounded. The shock he does get is, of course, dependent on the resistance of the lamps and line. But on the other hand, as I understand the accident, one end of the line slips from the lamp terminal while held in his hand, the lamp is cut out, and the circuit completed through his body.

Leaving the question of "extra current" for the moment, all the lamps on the line must go out, or nearly so, and the line current is greatly reduced on account of the man's great resistance, and nothing like 9 ampères could be forced through his body by a 2,200-volt dynamo.

With the best possible conditions, such as large, moistened electrodes, a man's resistance from hand to hand would hardly go below 600 ohms. To get 9 ampères through him it is readily seen that the tension would have to be over 5,000 volts, and in a few seconds the man would probably be "cooked."

The "extra current" or "kick," as it is sometimes called, caused by one breaking a metallic circuit and simultaneously completing it through his body, is admitted to be an extra rush of induced current, but accompanied by an enormous momentary increase of voltage—a phenomenon something like a static discharge from the dynamo and line. Such a shock is very severe and may sometimes prove deadly, even when occurring in a low-tension system.

The well-known writer of the previous article seems to have omitted the question of the man's resistance—to my mind the most important point in considering the fatality of the electric shock.

It is a well-known fact that a horse is a delicately organized, sensitive, nervous animal.

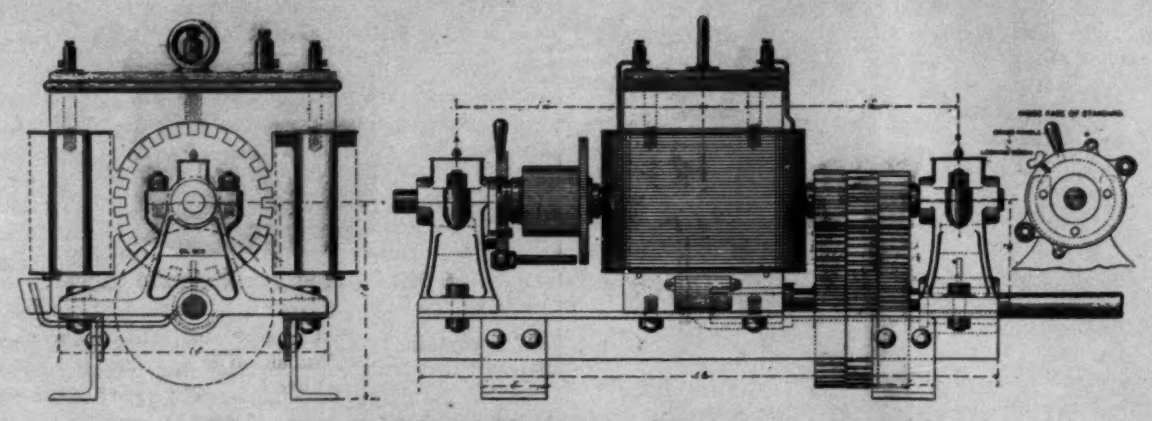
The electric shock has a greater effect on him than on most other animals or, presumably, on a man. That a horse should be killed by a 300-volt dynamo of any make is, therefore, not very surprising; but the man must have been more scared than "severely shocked" by a 300-volt direct current. Many employés in stations using 300-volt machines can place their hands on the terminals, and keep them there.

To conclude: I think, in speaking of electric shocks, it is not only preferable, but right, that we designate them by their voltage, with a total disregard of the ampèrage (if above one ampère), when we consider that with any voltage in use it is impossible to force more than one or two ampères through a man's body, no matter what the ampèrage of the line; but if a man does experience such a current his life is in danger. E. C. BOYNTON, M. E.

LIBRARY OF THE UNIVERSITY OF CALIFORNIA

The "Industries" Prize Electric Motor.

Our readers will remember that more than two years ago the English journal *Industries* instituted a prize competition in electric motors, in which 100 guineas was to be awarded to the designer of the best machine fulfilling certain specified conditions. In this competition two designs submitted were considered of such equal merit that it was decided to construct the machines in order to ascertain by practical test the relative merits of each. As the result of these tests the prize has been awarded to the joint designers of one of the machines, Mr. F. V. Andersen, electrical engineer to Messrs. Latimer Clark, Muirhead & Co., Ltd., and Mr. J. O. Girdlestone, engineer to Messrs. B. Verity & Son, London. The accompanying



FIGS. 2 AND 3.—THE "INDUSTRIES" PRIZE ELECTRIC MOTOR.

engraving, Fig. 1, shows the motor in perspective, and Figs. 2 and 3 show a side and end elevation. The tests of the motor show the following results:

Electrical h. p. supplied.	Speed of motor spindle.	Mechanical h. p. given off at motor spindle.
11.81	248	7.31
14.85	295	10 60
12.70	252	9.48

The motor is series wound, the resistance of the armature being 0.061 ohm; total, 0.126 ohm. The weight of the motor without pulley is 985 lbs. It is designed to work with a current of 150 volts pressure, and a speed of motor spindle of 250 revolutions per minute. According to the terms of the competition, the weight was not to exceed 950 lbs., the speed of the motor spindle was not to exceed 250 revolutions per minute, the pressure was not to be less than 100 or more than 500 volts, and a commercial efficiency of 80 per cent. should be aimed at. The prize motor, although falling short of the standard of perfection, has been considered by the judges to come sufficiently near it to merit the award.

Mr. W. H. Preece, Prof. G. Forbes and Prof. W. G. Adams were the judges of award.

Consolidation of Edison and Sprague Interests.

One of the notable events of the past week has been the carrying out of another part of the programme of the Edison General Electric Company, namely, the acquisition of the Sprague Electric Railway and Motor Company, whose motors, etc., have so long been built at the Edison Machine Works, at Schenectady, and have given so extensive a development to the business of incandescent stations and to the introduction of electric railways throughout the country.

When interviewed on the subject last week, Mr. E. H. Johnson said that he has for many years held the opinion, and given it expression on all suitable occasions, that the title given to the Edison electric generating stations was a misnomer; that they are not primarily "electric lighting," but electric power stations. It is true that their output in the first instance was mainly for electric lighting, but that was solely in consequence of the fact that the commercial electric lamp preceded the commercial electric motor. Now that electric motors are being generally adapted to the various industries heretofore employing other kinds of motive power, the fact is becoming apparent that the electric power business is rapidly rivaling the electric light business, and will unquestionably, in the near future, far surpass it in the amount of capital employed and horse power consumed. It was in consequence of these views that he was first led to take an interest in the development of the electric motor which ultimately resulted in the practical evolution of the ideas of Mr. Frank J. Sprague and the formation of the Sprague Electric Railway and Motor Company. This enterprise was carried on by him in friendly alliance with the Edison electric light interest, with the constant idea of sooner or later effecting a union of these two commercial industries. The conversion of natural or artificial power into electricity; the distribution of that electricity over large industrial areas and its re-conversion into light or power, according to the requirements of the community to be served, is a natural union constituting a single physical and therefore properly a single commercial enterprise.

With this main idea and purpose always in mind, it is not therefore strange that Mr. Johnson has finally been able to effect the actual consolidation of the Edison and Sprague companies. He claims that, based as they both unquestionably are upon fundamental patents—Edison for generating and distributing and converting into light, and Sprague for distributing and converting into power—it requires no great stretch of the imagination to foresee a future for the combination equalled by no new industry, not excepting the telephone, which this most fruitful of inventive nations has as yet produced.

The general terms of the consolidation are understood to be the acquisition of the Sprague Company's stock by the Edison General Company, on the basis of an exchange of Edison stock for the Sprague stock, share for share, payable in the Edison General Stock and Trust Certificates in the proportion of 66⅔ of a share of General stock and 33⅓ of a share of Trust Certificates for each share of the Sprague stock. It is also understood that the Sprague organization will be maintained precisely as it now exists, and that its business arrangements will be in no wise disturbed. It is not, however, likely, from what can be gathered, that Mr. Johnson will remain as president of the Sprague Company, he having frequently expressed his determination to take advantage of this opportunity when it came to retire permanently from official connection with the enterprise in order to give attention to numerous private matters which have been accumulating and suffering for lack of that personal attention which they needed.

The New Edison Primary Battery.

The widespread use of the dynamo as a source of current has necessarily lessened the importance of the primary battery as a source of electricity, but there are, nevertheless, many situations in which it still holds its ground. Thus, although a number of the largest central telegraph offices have dynamo equipments, the vast majority are still operated by means of the gravity or some other form of cell; and, in addition, many thousands of open circuit cells are used every year in telephone work, call-bells, annunciators and a variety of other services.

Although Mr. Edison has devoted almost his entire attention for a long time past to dynamic electricity, he has recently given some attention to primary battery work, with the result that the Edison Manufacturing Company will soon place upon the market a cell perfected by Mr. Edison.

The cell consists of a cylinder of zinc and a plate of compressed peroxide of copper immersed in a caustic potash solution.

This type of cell has the valuable property of being equally well adapted for both open and closed circuit work, as the local action is practically nil. Another valuable property of the cell is its very low internal resistance, which is only .025 ohm, and remains constant during the full life of the cell. The E. M. F. of the cell is .7 volt on heavy work, .8 volt on light work, and .95 volt on open circuit. On short circuit the cell is capable of delivering 15 ampères. At the present time three different sizes of these cells are being made, viz.: of 15, 150 and 300 ampère hours capacity, respectively, and one of 600 ampère hours is in contemplation.

The low internal resistance of the cell makes it eminently applicable to telegraph work, especially in such cases where a number of lines are fed from the same battery. The battery is also said to be equally well adapted for driving small electric motors and for electro-plating. As stated above, the cell can be used equally well on open circuit work, as it does not polarize, and here its low resistance is also a valuable factor.

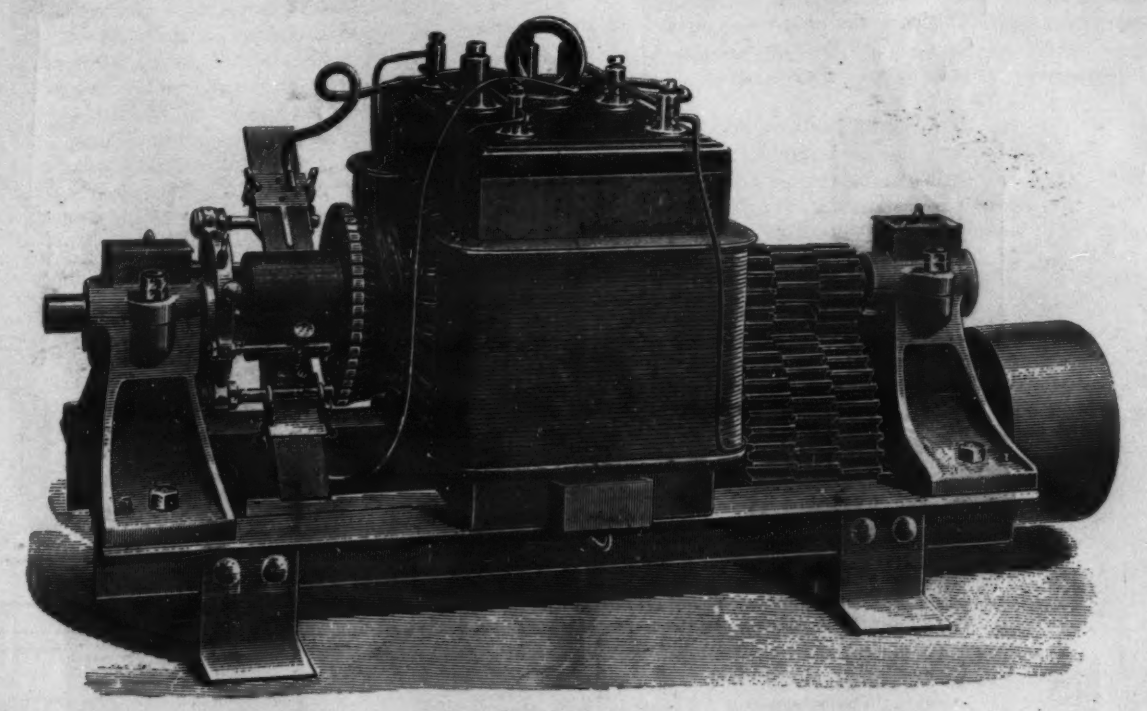


FIG. 1.—THE "INDUSTRIES" PRIZE ELECTRIC MOTOR.

Smith's Method of Making Amalgamated Storage Battery Plates.

One of the methods which has been largely employed in the past in order to prevent the oxidation of the supporting plates in a storage battery has been the amalgamation of the plate. This has generally been effected by adding to the molten lead a certain quantity of mercury. This process, however, does not always give uniform results, on account of the volatilization of the mercury, so that the exact quantity combining with the lead is uncertain. To avoid this inconvenience, Mr. Walter F. Smith, of Philadelphia, has devised a method by which an amalgam previously prepared is added to the molten lead in definite quantity.

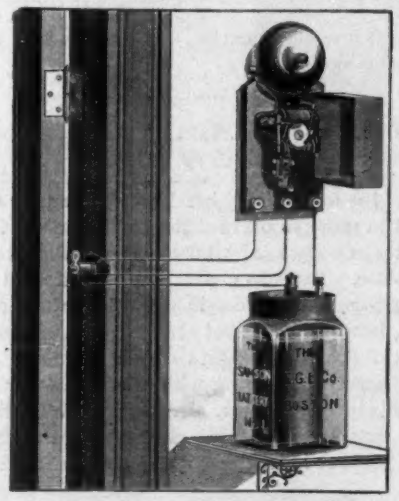
The manner in which the amalgam is prepared involves an electrolytic process, and is accomplished as follows:

A quantity of mercury is made the cathode of a cell and metallic lead the anode, a dilute solution of nitrade of lead constituting the electrolyte. A current of electricity is then passed through this electrolytic cell and the ensuing electrolysis allowed to continue until the mercury has permeated a large proportion of the lead. The amalgam thus formed is then placed in a straining appliance, and the nitrate of lead removed by washing and the excess of mercury strained off, leaving the mass in a plastic condition suitable for combining with molten lead. In practice it has been found that about four per cent. of the amalgam introduced into the lead before casting the compound into supports gives excellent results and prevents oxidation.

Oriental Telegraph Ciphers.

It may have occurred to many people that the Chinese written language, with its vast array of ideographs, would be most unsuitable for telegraphic purposes, yet this is far from being the case. Almost the solitary advantage which their cumbrous system may be held to possess, says the *London Electrical Engineer*, is that the true meaning of any one symbol cannot possibly be confounded with that of any other of the 120,000 words which are to be found in a Chinese dictionary. Every character is complete in itself and forms a perfect word picture. In their telegraphic system they had recourse first of all to the engraver, who provided box-wood blocks having on one face the word-picture in relief, and on the opposite side a number corresponding to that in the catalogue which was compiled for the purpose, and which comprises all the symbols in general use, about 10,000. The numbers run from 0001 to 9,999, and when any given number is signaled in the telegram, the translating clerk at the telegraph station is able to pick out the block required from his type-case and stamp an impression of it upon the paper which is delivered to the addressee of the message. Unless, therefore, the number be wrongly signaled, there is no possibility of the sender's wishes being misinter-

preted. The catalogues are purchasable by the public, and by arrangement with his distant correspondent it is competent for a merchant to compose his message of numbers, which shall be, say, 10 or 100, in advance of those really intended, forming a practical cipher, which can only be understood by the initated. Naturally, such a cipher is exeeedingly valuable when telegraphing to places beyond the confines of China—the Chinese legations at foreign Courts, for example, are readily able to correspond with Pekin in a code which even "barbarians" cannot comprehend. The Japanese language requires forty-nine combinations of dots and dashes to translate it into the Morse



A Limited Alarm Vibrating Bell.

code, so that some additions to the original alphabet were necessary, but now they are able to correspond in their own tongue by wire with the utmost facility, the clerks being trained to signal either European telegrams in the 26 letters of the English alphabet, or native messages in the 49 syllables of the Japanese language. The charges for native messages are based upon the number of signals, and a message of 20 syllables, independent of the address, is sent 100 miles for about four cents. Japan possesses a most complete network of wires, connecting every town and large village with the capital. They extend for something like 3,000 miles in all directions, and are worked with perfect regularity and at as high a rate of speed as obtains anywhere out of Great Britain. The Chinese have not reached anything like so high a standard of development, but it is something to be able to say that they have lines of telegraph there at all. The Celestial Empire makes very slow progress, but nevertheless it is sure. In the matter of cipher telegrams they can at all events claim to have a system about as complete, and yet simple, as could be devised.

Daimler's Petroleum Motor for Driving Dynamos.

The demand for domestic electric lighting plants, where current is not obtainable from a central station, has led to the production of a variety of small engines, designed to operate with as little attention as possible. Among the most recent of these is the Daimler petroleum motor, illustrated in connection with a dynamo in the accompanying engraving. The machine consumes petroleum, which is vaporized and then conducted to the cylinder of the engine, and there ignited. To start the motor, it is necessary to give two or three turns of the crank attached, upon which the motor proceeds under way at full speed. Owing to the high speed at which the engine runs, it can be belted direct to the dynamo without counter shafting. These motors, which are built by the Daimler Motor Company, of

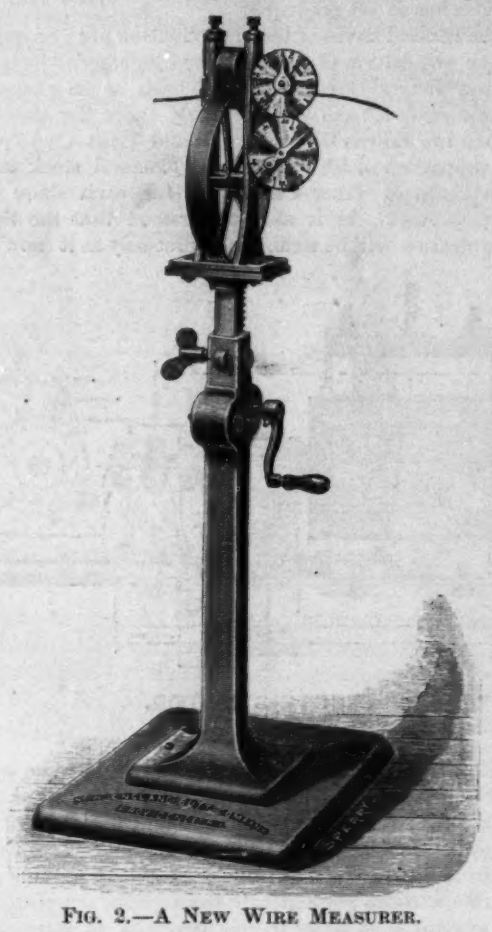


Fig. 2.—A New Wire Measurer.

Steinway, Long Island City, N. Y., range in size from 1 to 10 h. p. The one illustrated is of 1 h. p. capacity, and weighs 240 pounds complete. Its height is 39 inches, and it occupies a floor space of 18 × 15 inches.

A Limited Alarm Vibrating Bell.

We illustrate this week an ingenious alarm bell to be used as a door alarm, but which has the decided novelty of only ringing for a limited time. In the old style of door alarms, if the door is left open the bell continues to ring and becomes a source of annoyance as well as a waste of battery current. The limited alarm bell has, as shown in the cut, a round disc on its front which forms part of the electrical circuit by means of two springs resting on its periphery. This disc, as soon as the circuit is closed, is made to revolve by means of a small pall attached to the vibrator of the bell, which gears into a ratchet on the back of the disc. The disc is cut away on one side, so that when turned toward the spring the circuit is broken and the bell stops ringing. By using a special door spring, on closing the door again the other spring, which is still resting on the periphery of the disc, is put in circuit and the bell rings again until the flat place is opposite the spring, when the circuit is broken. Three terminals are required on the bell, as there are two distinct circuits, which are operated by the door spring. The instrument promises to be a very useful improvement, and is made solely by the Electric Gas Lighting Company, of Boston.

A Switchboard for Electric Clocks.

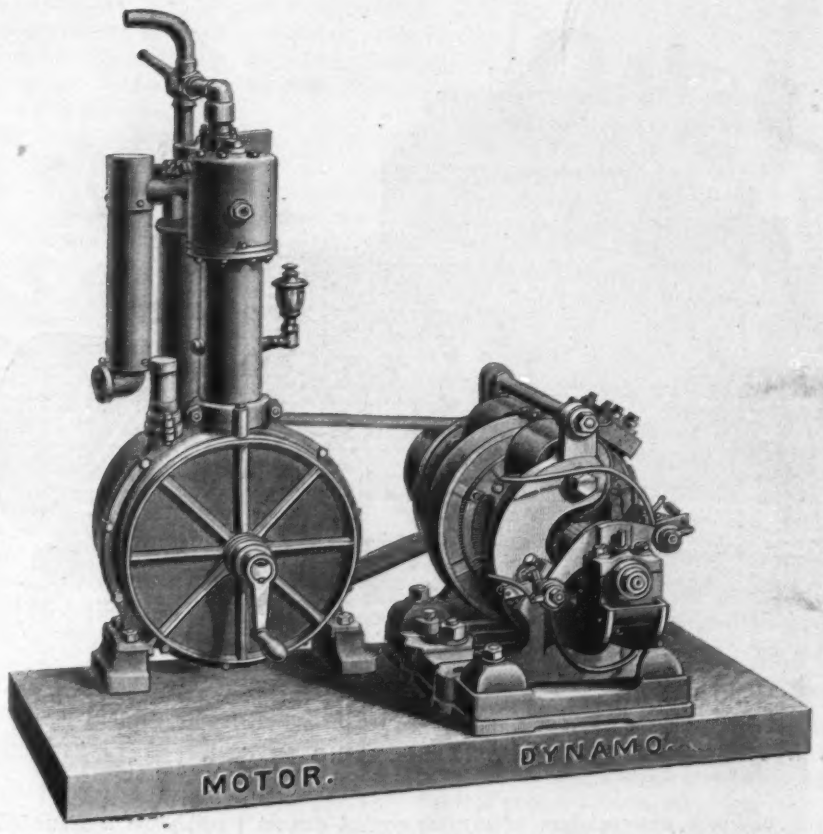
Among the recent improvements made by the Standard Electric Time Company, of New Haven, Conn., in their electric time system, is a single-circuit switchboard for use with tower clocks. A circuit-closer on the tower clock movement operates the clocks through the switchboard,

A Switchboard for Electric Clocks.

which contains an electric gauge, indicator clock, jumping key and switch plates for dividing the circuit in case of trouble. An alarm attachment is also a part of the switchboard, which rings a bell shown, in case the circuit is broken. This switchboard is being extensively introduced in public buildings where it is desired to attach secondary dials.

The New Braiding Machine and Wire Measurer of the New England Butt Company.

We illustrate in the accompanying engraving, Fig. 1, the latest product of the New England Butt Company, of Providence, R. I., consisting of a heavy braiding machine for



DAIMLER PETROLEUM ENGINE WITH DYNAMO.

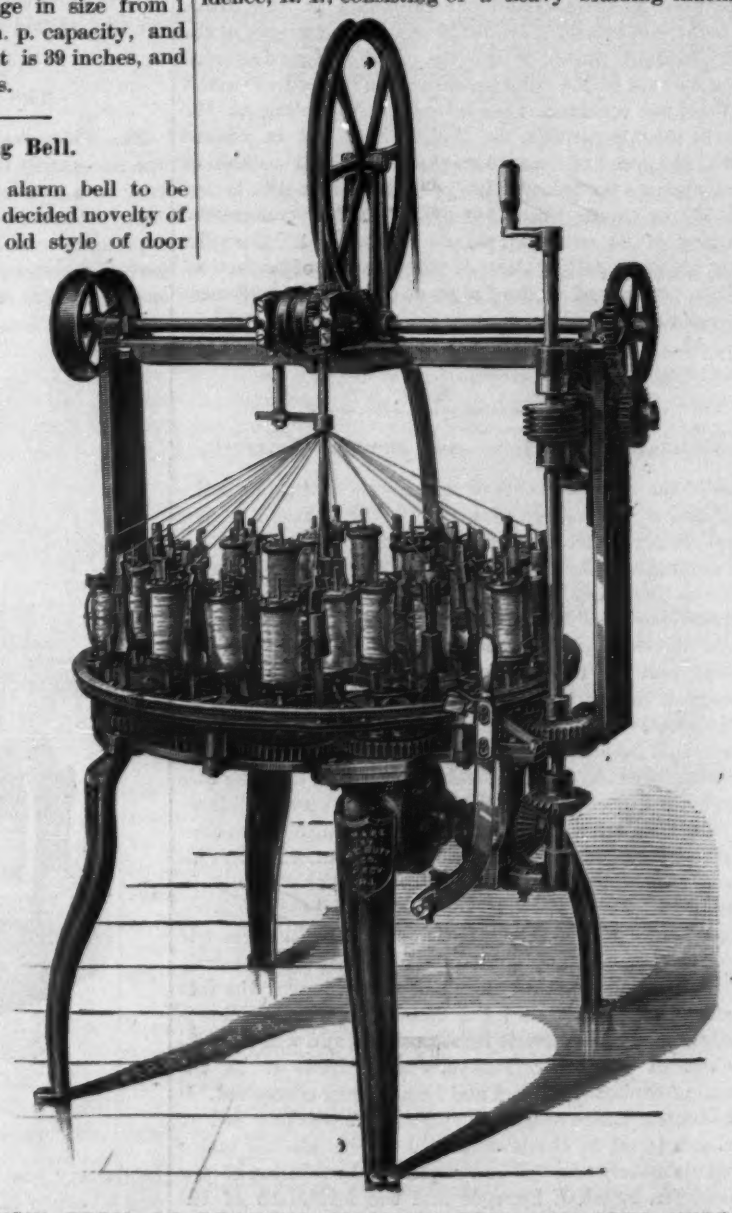


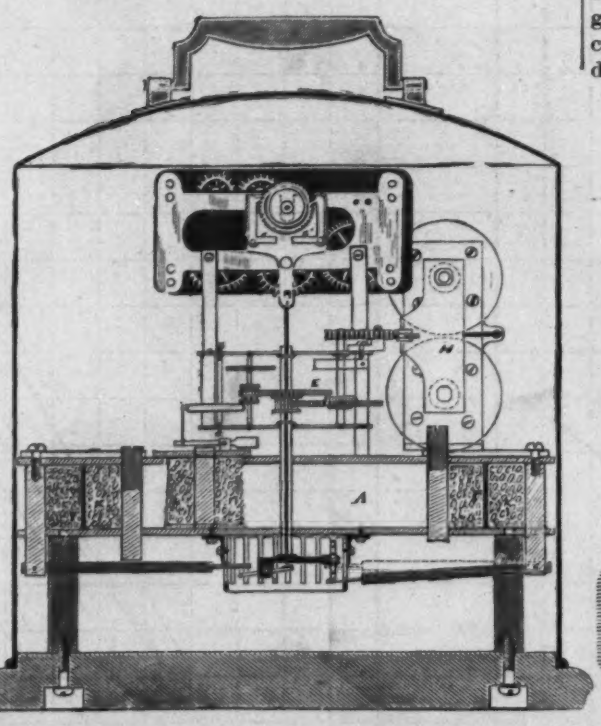
FIG. 1.—NEW FORM OF BRAIDING MACHINE FOR INSULATED WIRES.

covering cables and large wires. The machine is built strong and powerful in all its parts, and carries a spool 4½ by 3 inches, which admits of the use of a large size covering material. A 9-inch carrier is used with weights varying from 3 to 20 ounces. The machine is built in two forms of take-off, that is, with scored feed rolls, as shown in engraving, and with large wheel feed, after the style of the smaller machines. A reel fixture and reel for taking the covered wire from the machine, placed on the floor at the back, is furnished when desired.

The machine weighs 575 pounds, and is powerful enough for the heaviest class of work. At present, four sizes, 16, 4,2 48 single, and 16 by 24 spindle double, machines are

being built, and other sizes are in course of construction.

The machine for measuring wire is shown in the engraving, Fig. 2. Its use in many situations will be apparent at once. The machine is so constructed that it is adjustable in height, and registers the amount of wire passed through it, ranging from 10 to 5,000 feet. The machine is also built without a standard, so that it can be placed on a work bench.



FIGS. 2, 3 AND 4.—THE MANWAREN ELECTRIC METER.

The Manwaren Electric Meter.

Various devices have been employed to register the amount of current passing in a circuit, and those in which clockwork has been employed for that purpose have been often essayed. Among the recent ones of this type is that which has just been brought out by Mr. Albert H. Manwaren, of Philadelphia, in which several novel arrangements are employed. This meter consists essentially of a compound or multipolar magnet, a number of armatures and a registering device, the action of which is controlled by the position of the armatures. In addition there is an electrically-operated winding device for the registering mechanism.

The accompanying engraving, Fig. 1, shows the meter in section, and Figs. 2 and 3 respectively a top and bottom view of the main working part.

Referring to Fig. 1, *A*, it will be noted, is the compound or multipolar magnet operating a series of armatures supported by the outside row of posts, and the inner ends free to move in the vertical slots of the central ring.

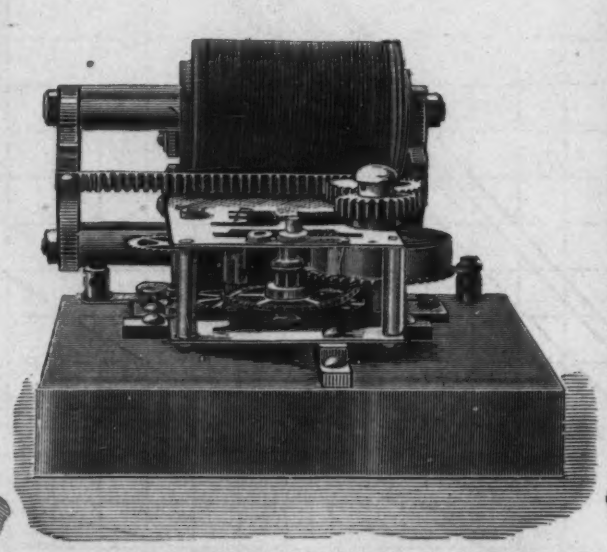
The inner posts or cores are provided with a screw or thread for adjustment, which is made by graduating the distance of the cores from the armatures according to the quantity of current traversing the coils. Suppose, for instance, that the adjustment is made for lamps of 8 c. p., then the current of one 8 c. p. lamp will raise the first armature, and by adding one more lamp of the same power the second armature is raised, and so on, up to the capacity of the meter. Now, if one lamp of 8 c. p. and one of 16 c. p. be used, three armatures will be attracted; and if one lamp of 32 c. p. be added, four more armatures will be raised, making seven armatures raised in the path of the registering trip, which registers the same as if seven lamps of 8 c. p. were burning. Thus, by means of this meter, lamps of different candle power can be used at the same time and accurately registered, which is one of its important features.

In Fig. 1, also, the clockwork is shown having a hollow shaft supporting an arm at the lower end carrying the registering trip, which is rotated by the clockwork. The trip passing in under the end of the armatures that are up in its path, is depressed at the outer end, and the inner end raises the rod, which is free to move in the hollow shaft. The rod is connected to the movable plate supporting two pawls (push and pull), which is raised one tooth of the gear-wheel and allowed to drop of its own weight as soon as the trip has passed the armature acted upon. The trip or lever is rotated by the clockwork once around in six minutes, thus making a new register of the exact number of lamps burning every six minutes.

Each indication of the hand or pointer is equal to one lamp of 8 c. p. burning six minutes, or whatever candle power is used for a standard and the meter is adjusted to.

On one end of the rotating arm is a treadwheel, used to force all the armatures down in advance of the trip, and only those adjusted to the quantity of current flowing through the coils *K* and *K'* will be attracted again.

In Fig. 1, *H* represents an end view of the automatic winding device, better shown in Figs. 4 and 5. This is a very simple arrangement, composed of two solenoid magnets, with one-half the core of each made of non-magnetic material. The yoke is used to support the rack, which is geared to the winding shaft of the clock. When the circuit is closed by means of the contact rod, the cores are drawn in the magnets, and in so doing the rack bar acts on the gearing and winds the spring. When the core has moved its full length, a stud on the yoke pushes the contact rod shown in Fig. 4, away from the contact plates and opens the circuit. The spring now operates on the clock mechanism, and the rack bar shown in Fig. 5 is slowly moved to the length of its travel. At this point a stud, projecting from the rear end of the yoke, moves the rod in contact with the plates, closing the circuit, and causing a prompt back movement to wind the spring as before; this occurs every twenty minutes, and is entirely automatic in its action.



FIGS. 1, 5 AND 6.—THE MANWAREN ELECTRIC METER.

The arrangement for stopping the clock when there is no current being used is shown in Fig. 1. It consists simply of a small magnet connected in series in the lighting circuit, operating an armature which acts upon the balance wheel; the clock is started automatically by the movement of the armature when it is attracted again.

The engraving Fig. 1 shows the wire *K* and *K'* wound in two coils, allowing the meter to be used for double the original capacity, by connecting the two coils in multiple arc, which gives a 25-light meter the carrying capacity for 50 lights. The armatures are then attracted in this manner: It requires the current of two 8 c. p. lights to operate the first armature and four 8 c. p. lamps for the second armature to be attracted, and so on. The meter connected in this way will always register within one lamp of the actual number burning, but is only intended to be used in this way in case of emergency. It is of course understood, in taking readings, that each indication represents two lamps burning six minutes. It is not necessary to adjust this meter to 8 c. p. lamps or any special volt lamp, as it can evidently be used for any candle power or voltage desired.

The meter registers the length of time each lamp is burning or the quantity of current used, and the consumer has full access to the reading of the dial.

The meter is small and is not limited in construction to any particular number of lights. A 25-light meter is 7 inches in diameter and 8 inches high, weighing ten pounds; a 100-light meter is 12 inches in diameter and 10 inches high; while a 200-light meter is the same diameter and 2 inches higher. The large meters are constructed with several compound magnets, each having a set of armatures and a trip with one magnet placed above the other and one clockwork with the hollow shaft extending through all the different coils; this revolves all the different trips, which are set one rotation in advance of the other, so that only one trip is registering at a time. By this method a 500-light meter composed of five 100-light coils placed one above the other, as mentioned above, is twelve inches in diameter and fifteen inches high, making it convenient for transportation and requiring but a small space. The engraving, Fig. 6, shows the meter as it appears inclosed in a protecting case.

On the Heating of Conductors by Electric Currents.

BY A. E. KENNELLY.

III.

On the Heating of Bare Copper Wires and Strips Suspended in Air Within Doors.

It has been shown by Professor Forbes and others that for bare cylindrical wires suspended in air, the temperature elevation produced in them by a current will be proportional directly to the square of the current and inversely to the cube of the diameter, provided that the loss of energy per unit surface of wire per second, known as the emissivity, be itself directly proportional to the temperature elevation. This assumption, though frequently made, is recognized to be untrue, and consequently this law cannot apply rigorously to suspended bare wires, just as it has been shown to be only approximately true for empaneled wires. Experiment shows that the emissivity rises rapidly with the rise of temperature, being in some cases nearly twice as great per degree Cent. at 100 degrees as it is at 20 degrees Cent. of temperature elevation.

Hitherto in calculating the limiting temperature of a bare wire suspended in air the emissivity has been generally taken from the data supplied by the careful experiments of Messrs. McFarlane and Nichols, who observed the rate of cooling of large metal spheres in special inclosures, conditions which are not fairly applicable to the cooling of wires, and which cannot, as Professor Forbes himself pointed out, be strictly depended upon for that purpose.

He suggested that the effect of convection was not proportional to the surface, while radiation was; and experiments have verified this belief. Thus the emissivity for a polished copper surface in the experiments of McFarlane and Nichols was about 0.000168 therm per degree Centigrade between 0 degree and 60 degrees Centigrade. With this value Forbes and others have been led to greatly underestimate the carrying capacity of bare suspended wires, In the table accompanying his paper already mentioned, the calculated currents to raise the temperature of bright copper wires of 0.040 inch and 0.120 inch diameter 49 degrees Centigrade are 6.5 and 33.5 ampères, respectively; while experiment shows that about twice as much current is needed in each case. In fact the emissivity per degree Centigrade has been found to vary from 0.00019 therm with a thin flat bright copper strip to 0.001364 therm with a bright copper wire 0.0356 inch (0.0904 centimetre) diameter, at about 50 degrees Centigrade temperature elevation, or in the latter case some eight times as great an emissivity as that quoted from the previous data.

A hot wire suspended in air parts with its heat both by convection and radiation. These two processes are essentially distinct, and are governed by different laws, so that the complete treatment of the subject can only be attained by dealing with each separately and summing their effects. The experiments to be described have succeeded in determining up to temperature elevations of 100 degrees Centigrade the separate rates of convection and radiation, together with the conditions to which they are independently subject. It is true that to determine all these conditions accurately would demand much further investigation, but the results appear to be at least reliable as a good first approximation.

Instead of dealing with the emissivity in therms, as has been customary, it will be more simple and direct to give all the results in watts.

Fig. 6 represents the temperature elevation measured with different current strengths passing through uninsulated copper conductors suspended in air within doors. Five different conductors were tested, and of these four were copper wires of diameters from 0.0356 inch (0.0904 cm.) to 0.1345 inch (0.341 cm.). The fifth was a strip of bright brush copper, 1 inch (2.54 cms.) wide and 0.0065 inch (0.0165 cm.) thick. Curves I., II., III., IV., V., VI. and VII. are the traces of the observations made upon them. Their surfaces were all brightened with fine emery paper, except that of the strip, which needed no polishing. The wires were suspended about 8 feet (250 cms.) above the floor, between opposite walls of the laboratory, in the still air with the windows closed. These precautions were taken because it was found that a comparatively small disturbance of the air exercised a decided cooling influence on the wire. Thus a fan gently waved beneath and at right angles to one of these 25-foot lengths of wire under test produced a diminution in its resistance that was plainly discernible, and arrangements were therefore made to keep the air as free from disturbance as possible. For the same reason all the observations, though they reached their practical maxima much more quickly than had been the case with the paneled wires, were more variable and never remained quite steady. The readings had consequently to be repeated several times and means taken to obtain fair results.

The emissivity of the strip (in its upright position, to be later described) proved to be 0.24 watt per linear centimetre, at 50 degrees Cent. temperature elevation, its surface per centimetre being 5.11 sq. cms., while the emissivity of the smallest wire was 0.08 watts per linear centimetre at the same temperature elevation, its surface per centimetre being 0.284 sq. cms. Both these measurements being referred to the unit surface instead of unit length, give, respectively, 0.047 and 0.28 watts per sq. cm., thus making the emissivity of the small wire about six times as great as that of the strip for the same temperature elevation. From this great discrepancy it appeared probable that the convection, instead of being proportional to the surface, like radiation, was equal in both cases, or nearly so; for if the convection had been proportional to the surface the mere difference in the form of the two conductors, whose surfaces were of similar appearance, could hardly account for so large a discrepancy. By assuming the convection to be equal for both wire and strip a pair of simultaneous equations was supplied by each pair of corresponding elevation points in the observation curves, thus giving radiation and convection independently for each such pair. The results for the radiation obtained in this way are:

Radiation for both wire and strip:

	Watts per sq. cm.
At 10 degrees C. temperature elevation	0.004765
" 20 " " " "	0.01057
" 30 " " " "	0.01720
" 40 " " " "	0.02466
" 50 " " " "	0.03312
" 60 " " " "	0.04103
" 70 " " " "	0.04995
" 80 " " " "	0.05927
" 90 " " " "	0.06796
"100 " " " "	0.07790

a rate of increase considerably beyond arithmetical progression. The test of the accuracy of the assumption on which these figures are obtained must be the accordance of this series with the laws of radiation as they are independently known.

MM. Dulong & Petit have published in the seventh volume of the Annales de Chimie et de Physique, 1817, a

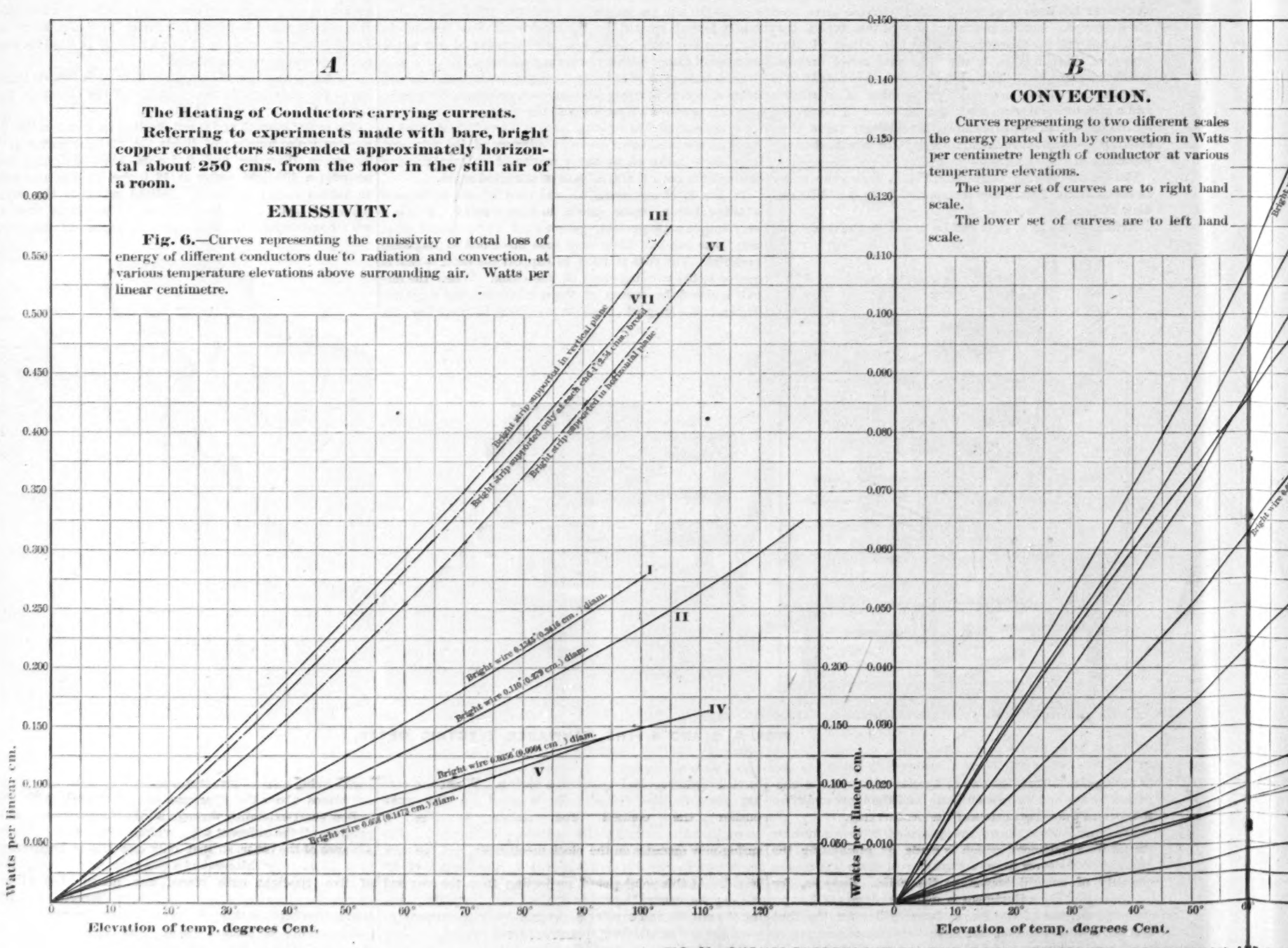

A
The Heating of Conductors carrying currents.
Referring to experiments made with bare, bright copper conductors suspended approximately horizontal about 250 cms. from the floor in the still air of a room.
EMISSIVITY.
Fig. 6.—Curves representing the emissivity or total loss of energy of different conductors due to radiation and convection, at various temperature elevations above surrounding air. Watts per linear centimetre.
Watts per linear cm.
Elevation of temp. degrees Cent.
III
VI
VII
I
II
IV
V
Bright strip supported in vertical plane
Bright strip supported only at each end (2.54 cms.) broad
Bright strip supported in horizontal plane
Bright wire 0.1345" (0.3416 cm.) diam.
Bright wire 0.116" (0.279 cm.) diam.
Bright wire 0.057" (0.0904 cm.) diam.
Bright wire 0.028 (0.1172 cm.) diam.
B
CONVECTION.
Curves representing to two different scales the energy parted with by convection in Watts per centimetre length of conductor at various temperature elevations.
The upper set of curves are to right hand scale.
The lower set of curves are to left hand scale.
Watts per linear cm.
Elevation of temp. degrees Cent.

FIG. 36.—CURVES REPRESENTING THE TOTAL EMISSIVITY CONVECTION AND RAD

veritable poem in physical investigation upon the laws of cooling bodies. In their experiments the radiation was found to vary with the temperature elevation in geometrical progression expressed by the equation:

$$h = c\,(1.0077)^{\theta}\left\{(1.0077)^{t} - 1\right\};$$

where h is the quantity of heat lost by radiation from a hot body per square centimetre per second; c, a constant depending on the nature of the radiating surfaces; θ, the temperature of surrounding bodies, and t the temperature elevation of the hot body in degrees Centigrade.

Taking this formula as representing the best existing knowledge of the rate of radiation with temperature, the test of the above assumption is in the accordance of the above series of calculated radiations with a similar series obtained from Dulong & Petit's equation. making t successively 10, 20, 30, etc., up to 100. The numbers so arrived at are:

$1.0077^{10} - 1 = 0.0797$	$1.0077^{60} - 1 = 0.5844$
$1.0077^{20} - 1 = 0.1658$	$1.0077^{70} - 1 = 0.7108$
$1.0077^{30} - 1 = 0.2587$	$1.0077^{80} - 1 = 0.8471$
$1.0077^{40} - 1 = 0.3591$	$1.0077^{90} - 1 = 0.9944$
$1.0077^{50} - 1 = 0.4675$	$1.0077^{100} - 1 = 1.1534$

To test the degree of accordance between the two series, the fourth element, corresponding to forty degrees Cent. (that being probably the most favorably situated for accuracy in observation), may be multiplied by 0.06866 to make it coincide with the calculated radiation 0.02466, and all the terms of the latter series may be similarly multiplied by the same factor. We then obtain the results given in the following table.

Temp. Elevation.	Dulong & Petit's series.	Factor of comparison.	Dulong & Petit's series referred to 40° C. elevation.	Calculated series from wire and strip.	Discrepancy.
10°	0.0797	0.06866	0.05473	0.04765	— 0 0007
20°	0.1658	.....	0.01138	0.01057	— 0.0008
30°	0.2587	.....	0.01776	0.01729	— 0.0006
40°	0.3591	.....	0.02466	0.02466	Standard.
50°	0.4675	.....	0.03210	0.03212	+0.00002minimum
60°	0.5844	....	0.04013	0.04103	+ 0.0009
70°	0.7108	... ...	0.04881	0.04995	+ 0.0011
80°	0.8471	.....	0.05817	0.05927	+ 0.0011
90°	0.9944	.....	0.06827	0 06796	— 0.0003
100°	1.1534	.....	0.07919	0.07790	— 0.0013maximum

This agreement must be considered very satisfactory, and it is difficult to suppose it merely coincidental. It not only strengthens the reliance to be placed on Dulong and Petit's law, but it also amounts to a demonstration that the convection does not depend upon the surface, or that at least it can only do so in a very limited degree.

The radiation in watts per square centimetre from a surface of bright copper may therefore be accepted as $0.0687\,(1.0077^{t}-1)$ under the condition of these experiments. But Dulong and Petit's law requires that this factor 0.0687 should itself be a function of the temperature of surrounding bodies, or in other words that the radiation loss from a hot wire for a given temperature elevation increases with the absolute temperature. It may therefore be assumed that

$$0.06866 = c\,(1.0077)^{\theta};$$

and in these experiments θ, the temperature of the surrounding air, was about 26 degrees Centigrade, so that

$$c = \frac{0.06866}{(1.0077)^{26}} = 0.05625.$$

Whence the complete expression for the radiation from a bright copper wire in watts per square centimetre is:

$$0.05625\,(1.0077)^{\theta}\,[\,(1.0077)^{t} - 1].$$

It is to be observed, however, that this factor $(1.0077)^{\theta}$ is a deduction only, as yet not verified by experiment. It is difficult to decide this point in the summer season, but it is hoped to determine the question of its existence experimentally during the ensuing winter by observing whether the radiation does vary to such a degree for given temperature elevations when the temperature of surrounding bodies is changed. Should this factor's existence be verified it would completely establish the application of Dulong and Petit's law. If, on the other hand, the variation is not to be detected, while it would certainly weaken the position, the general evidence, apart from Dulong and Petit's law, is sufficient to maintain the use of the term $[(1.0077)^{t} - 1]$ while the factor 0.06866 would necessarily be regarded as independent of θ. With this reservation the retention of the factor is probably justified, especially as for most practical purposes the question is not a vital one.

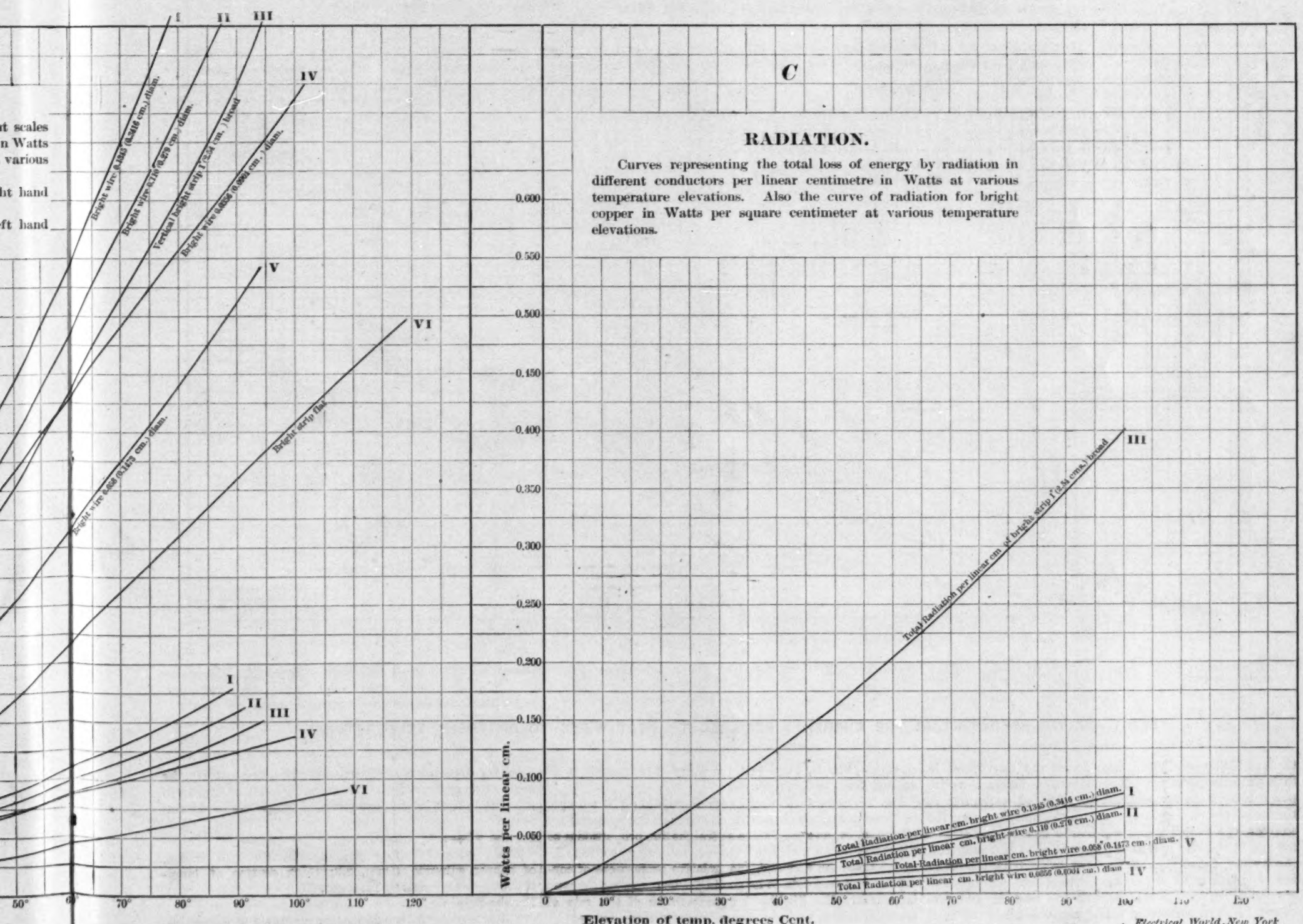
The following table gives the radiation in watts per sq. centimetre of bright copper for $\theta = 25$ degrees Centigrade and if the factor $(1.0077)^{\theta}$ be found to have an experimental existence it will be a simple matter to amplify the table for various values of θ from zero to 30 degrees Centigrade.

RADIATION TABLE IN WATTS PER SQUARE CENTIMETRE FOR BRIGHT COPPER.

Temper. Elevation. Degree Cent.	$(1.0077^{t}-1.)$	Radiation.
5°	0.0391	0.002685
10°	0.0797	0.00543
15°	0.1219	0.00831
20°	0.1658	0.0113
25°	0.2114	0.0144
30°	0.2587	0.0176
35°	0.3080	0.0210
40°	0.3591	0.0245
45°	0.4123	0.0281
50°	0.4675	0.0319
55°	0.5249	0.0358
60°	0.5844	0.0398
65°	0.6464	0.0441
70°	0.7108	0.0484
75°	0.7777	0.0530
80°	0.8471	0.0577
85°	0.9194	0.0627
90°	0.9944	0.0678
95°	1.0724	0.0731
100°	1.1534	0.0786

The radiation is thus roughly 0.0006 watt or 0.00014 therm per square centimetre per degree Centigrade, increasing in geometrical ratio; and one square metre of bright copper at 100 degrees Centigrade elevation would radiate about 800 watts.

The same series of simultaneous equations which gave the radiation values furnish also the convection for wire and strip and its rate of change. Fig. 6 gives the result of the analysis. Curves Nos. I., II., IV. and V., in the left-hand section (*A*) represent the total emission in watts per linear centimetre as actually measured, and as composed of both radiation and convection. In the right-hand section (*C*) the total radiation obtained in the above manner is represented in the corresponding curves I., II., IV. and V., drawn to the same scale. The difference at each pair of corresponding points between the total emission and the total radiation represents the convection loss, and this is given by the lower set of curves, I., II., IV. and V., in the central section (*B*) to the same scale, and also in the upper curves to this scale magnified five times for the benefit of clearer comparison. It will be observed that the convection was nearly the same in each case, the effect of increasing the diameter of the wire from 0.0356 inch



ECTION AND RADIATION OF BARE BRIGHT COPPER WIRES SUSPENDED IN STILL AIR.

Electrical World, New York.

TABLE OF CURRENT STRENGTHS CAPABLE OF ELEVATING THE TEMPERATURE OF BARE COPPER WIRES OF 98 PER CENT. CONDUCTIVITY SUSPENDED IN STILL AIR.

Diameter of conductor.		5 deg. C.		10 deg. C.		20 deg. C.		40 deg. C.		80 deg. C.	
Inches.	Cms.	Bright.	Blackened.	Bright.	Blackened.	Bright.	Blackened.	Bright.	Blackened.	Bright.	Blackened.
0.05	.....	7	8	12	13	15	16	22	23	28	31
0.10	.....	17	18	24	26	33	36	50	52	62	70
0.15	.....	27	30	38	43	53	60	74	84	100	114
0.20	.....	49	41	52	62	74	85	103	120	140	166
0.25	.....	38	55	67	81	96	114	135	161	185	224
0.30	.....	61	71	85	100	120	143	168	204	233	285
0.35	.....	73	87	102	124	145	176	204	249	282	350
0.40	.....	87	106	122	148	172	211	241	297	335	418
0.45	.....	101	124	142	173	198	248	280	348	392	492
0.50	.....	116	144	162	200	228	285	320	402	449	570
0.55	.....	131	162	184	228	260	325	362	460	510	650
0.60	.....	146	182	206	258	290	366	407	518	571	731
0.65	.....	162	203	229	288	322	408	452	578	636	820
0.70	.....	178	226	252	320	355	454	500	640	704	908
0.75	.....	196	249	276	352	386	498	550	704	772	1,000
0.80	.....	213	273	300	386	420	544	598	768	819	1,100
0.85	.....	232	300	324	420	456	591	648	838	908	1,190
0.90	.....	250	324	348	455	490	640	700	908	980	1,290
0.95	.....	270	332	375	492	530	692	752	982	1,060	1,420
1.00	.....	290	375	400	528	565	740	800	1,050	1,130	1,500
.....	0.20	12	13	18	20	25	27	35	38	47	53
.....	0.40	28	30	40	46	56	64	77	90	105	121
.....	0.60	45	50	63	75	90	105	125	150	172	206
.....	0.80	64	76	90	108	126	152	179	217	247	305
.....	1.00	85	104	120	147	169	207	236	290	329	410
.....	1.20	108	133	150	184	212	264	298	372	416	526
.....	1.40	132	163	184	230	261	328	364	461	512	652
.....	1.60	156	190	220	276	310	392	415	553	610	785
.....	1.80	180	230	256	326	360	462	510	650	715	924
.....	2.00	201	267	293	377	413	532	583	750	819	1,070
.....	2.20	237	308	330	430	465	605	662	858	928	1,220
.....	2.40	268	348	372	486	524	685	746	970	1,050	1,380

(0.0904 centimetre) to 0.1345 inch (0.3476 centimetre), that is, nearly four times, only appearing to increase the convection 20 per cent.; thus corroborating the results arrived at by the test of agreement with Dulong and Petit's law. The convection appears to increase rather more rapidly than the temperature elevation, except in the case of the smallest wire. This result is not in accordance with those of Dulong and Petit, who found the convection in their experiments with cooling spheres to increase as the power 1.233 of the temperature elevation, or according to the factor $t^{1.233}$. It is quite possible, however, that the convection for spheres may not be the counterpart of that for long wires, and it is to be observed that not only are the laws of convection a branch of hydrodynamics more complex than those of radiation, which does not appear to vary with the form of surface, but the number and precision of these particular experiments scarcely warrant any more definite deductions to be made in this direction. For practical purposes therefore it will be sufficient to take a mean value of the convection and to assume it to be proportional to the temperature elevation until further investigation may afford more precise information. We may, therefore, take the loss of heat by convection from any wire at the mean value of 0.00175 watt per linear centimetre in still air for each degree Cent. of temperature elevation; that is, 1 kilowatt for every 114 metres at 50 degrees Cent. temperature rise.

Fig. 6 (1) also shows that the total emission of a wire per centimetre may rise faster or slower than the temperature elevation, or may even trace a straight line proportional to the elevation for a certain distance, according to the dimensions of the wire and the relative proportions of convection and radiation in its cooling. The smaller the wire the greater the likelihood appears to be of the rate of emission falling behind the rate of rise in temperature.

Experiments were next made to determine the amount of variation that a difference in quality of surface could effect in the rate of radiation. For this purpose five wires of the same dimensions and material—that is to say, five lengths of the same wire—were suspended parallel and their surfaces coated with different substances. On another occasion five lengths of the same strip were treated and experimented upon in a similar manner. The results showed that in still air a black coating of sulphide of copper, produced by painting the bright surface with a solution of sulphide of sodium, reduced the temperature elevation corresponding to any given current nearly 30 per cent. both for wires and strips; while a coating of lampblack and shellac (dead black carpenter's varnish) similarly reduced the temperature of the strips nearly 50 per cent. This has a useful bearing upon bare copper conductors within doors, say in an illuminating central station, for if their surfaces are so large that the heat loss takes place principally by radiation (and for surfaces above 5 square centimetres per linear centimeter convection plays but a small part), the saving of energy produced by painting the conductors with this varnish will, through the lowered temperature and resistance, amount to $\frac{t}{6}$ per cent., where t is the previous temperature elevation. So that if these conductors be maintained at 50 degrees Centigrade elevation in the bright state this will fall to about 27 degrees Centigrade after painting, with a resultant saving of about 8 per cent. of the whole energy previously generated by the current in the painted length. This applies not only to bright copper, but also to copper that has become slightly tarnished by age, but may not apply equally to copper whose surface is encrusted with dust or smoke.

By first determining the radiation and convection for the bright wire and strip, then assuming the convection to be equal for the other coated wires and stripe, respectively, the mean ratio of the radiation from each quality of surface to the radiation of bright copper was calculated to be as follows:

For the wires:

Thin coating of brown shellac varnish, 1.6; thick coating of copper sulphide (CuS), 2.3; thick coating of lampblack made adherent by molasses, 2.0.

For the strips:

Thick coating of brown shellac varnish, 1.8; rather imperfect and thin coating of copper sulphide, 1.5; lamp-

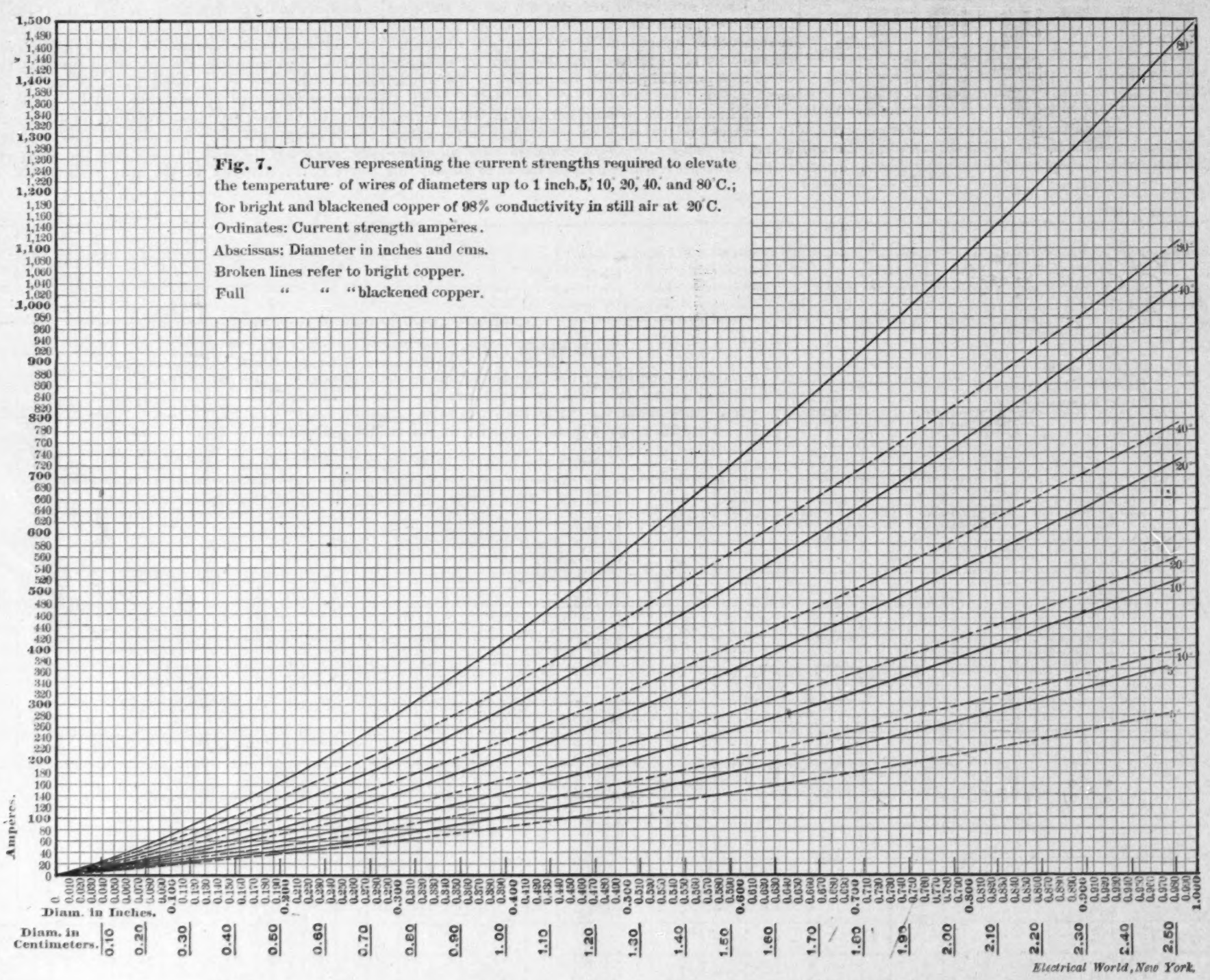


Fig. 7. Curves representing the current strengths required to elevate the temperature of wires of diameters up to 1 inch. 5, 10, 20, 40, and 80° C.; for bright and blackened copper of 98% conductivity in still air at 20° C.
Ordinates: Current strength amperes.
Abscissas: Diameter in inches and cms.
Broken lines refer to bright copper.
Full " " "blackened copper.

FIG. 7.—CURVES REPRESENTING THE CURRENTS REQUIRED TO HEAT WIRES TO DIFFERENT TEMPERATURES.

black by deposit from smoky candle, 1.4; thin coating of varnish, lampblack and shellac, 2.0.

The coating of copper sulphide was not so successful in promoting radiation with the strips as with the wires, partly owing, however, to imperfect coating. The necessity for a compact adherent layer in obtaining active radiation is also shown, for while lampblack, deposited from a flame, only added 42 per cent. to bright radiation, lampblack applied with thin shellac varnish doubled it.

We may, therefore, take the radiation from a properly blackened wire as double that from a bright wire.

Experiments were also made with two strips of bright copper to ascertain how far their convection was affected by their plane of suspension. In the above-mentioned tests of strips they were all secured at their extremities to lie flat; but toward their centre they each dipped to one side or the other out of the horizontal plane, making a dip of about 45 degrees, and the following tests were made to determine whether the convection depended to any extent upon this angle:

These two strips were supported in air at about every three feet, one of them being fixed in the vertical plane, while the other rested flat above all the supports. Their perpendicular distance apart was eight inches (21 centimetres). The testing current was sent through them in series and the temperature elevations determined for each in the usual way. Curves III. and VI., Fig. 6 (*a*) represent their relative behavior. In the first trial the temperature elevation of the flat strip reached 120 degrees Centigrade, at 101 ampères, while that of the upright was only 102.5 degrees C. To make certain that this difference was not due to any inequality of radiating power, the strips were exchanged in position, the upright one being now flat, and *vice versa*. On repeating the test, the emperature elevation of the flat strip reached 1; grees C. at 100 ampères, while that of the upright strip was 101.8 degrees C., practically the same result, and the only means of accounting for the difference was the plane of the strips. The diagram shows that the emission of the upright strip was greater than that obtained from it in the previous test while unsupported and drooping, and the emission from the flat strip less—a result quite in accordance with expectation.

Fig. 6 (*B*) gives the calculated values of the convection from the upright and flat strip. The latter is seen to be about 45 per cent. less than the former, a rather surprising difference, for it would indicate that, supposing the upper surface of the flat strip to be equally affected by convection to the same degree as one side of the upright strip, the convection from the lower surface would then be ten times less.

The final results of the experiments on bare wires in still air point to the following means of calculating the current strength necessary to raise any given copper wire to a certain temperature elevation:

Let d be its diameter in centimetres;
t " the given temperature elevation;
r " its resistivity at 0 degree C., in ohms;
θ " the temperature of surrounding objects;
m " the coefficient of surface for radiation.

Let $t + \theta = T$, the temperature attained by the wire.

Then its resistance per centimetre will be:

$$\frac{4\,r\,(1 + 0.00388\,T)}{\pi\,d^2} \text{ ohms.}$$

The energy developed per centimetre by a current of c ampères will be:

$$\frac{4\,c^2\,r\,(1 + 0.00388\,T)}{\pi\,d^2} \text{ watts per centimetre.}$$

The heat convected from it will be: $0.00175\,t$ watts per centimetre.

The heat radiated from it will be:

$$d\,m\,\pi \times 0.0687\left[(1.0077)^t - 1\right] \text{ watts per centimetre.}$$

Or if the radiation for t deg. elevation be taken from the previous table and denoted by R_t:

The total radiation per linear centimetre $= d\,m\,\pi\,R_t$ Watts. Equating the gain and losses,

$$\frac{4\,c^2\,r\,(1 + 0.00388\,T)}{\pi\,d^3} = 0.00175\,t + d\,m\,\pi\,R_t;$$

whence, $$c = 0.886\,d\sqrt{\frac{d\,m\,\pi\,R_t + 0.00175\,t}{r\,(1 + 0.00388\,T)}}$$

for copper of 98 per cent. conductivity $r = 1.65 \times 10^{-6}$; so that simplifying—

For bright wires:

$$m = 1,\quad c = 28.9\,d\sqrt{\frac{570\,Q\,R_t + t}{1 + 0.00388\,T}};$$

for blackened wires:

$$m = 2,\quad c = 28.9\,d\sqrt{\frac{1140\,Q\,R_t + t}{1 + 0.00388\,T}};$$

where $Q = \pi\,d$, the circumference of the wire.

The following table of current strengths capable of elevating the temperature of bare copper wires of 98 per cent. conductivity suspended in still air, 5 degrees, 10 degrees, 20 degrees, 40 degrees and 80 degrees, above surrounding air and objects at 20 degrees Centigrade, has been calculated for bright and blackened wires by the use of these formulæ. It will be observed that the currents are given up to 1,500 ampères, while 100 ampères was the experimental limit to which this series was carried. To present, however, a comparison of the results calculated in the table with those actually measured up to that limit the following may be noticed:

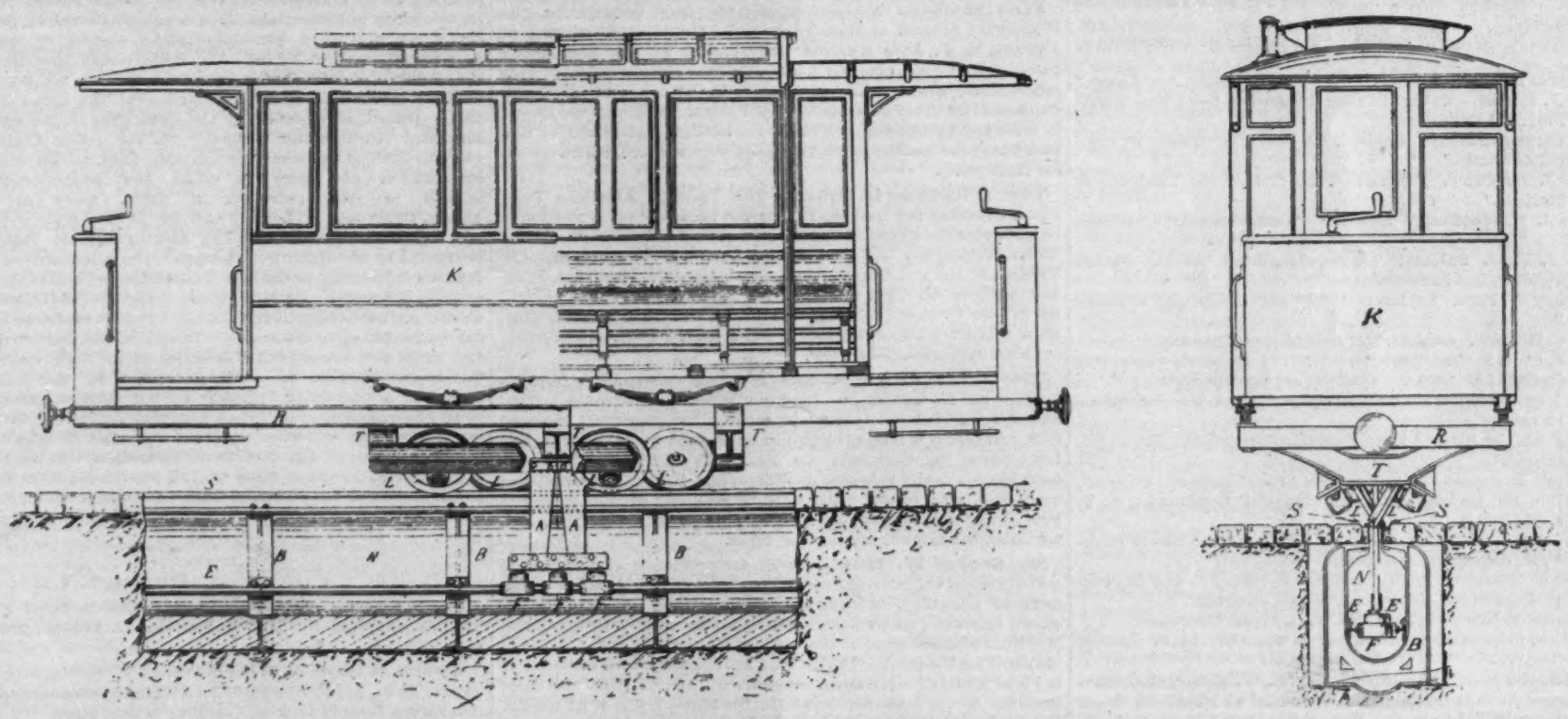
For elevation of						
5° C.,	the *observed* current was	24	ampères;	*tabulated*,	24
10° C.,	"	"	34.5	"	"	34
20° C.,	"	"	47.5	"	"	47.5
40° C.,	"	"	67	"	"	66
80° C.,	"	"	92	"	"	91

Fig. 7 gives the above table in graphic form, the continuous lines representing bright, and the broken lines blackened, wires.

THE "TRIPLEX" CLOSED CELL POCKET BATTERY.

The "Triplex" Closed Cell Pocket Battery.

Many physicians employ electricity as a therapeutic agent in their practice, and a portable form of electro-medical apparatus is much resorted to for that purpose. A very convenient form of pocket battery designed for this purpose is that shown in the accompanying engraving and called the Smith & Shaw "Triplex." The apparatus, as will be noted, contains three closed cells, the elements being carbon and zinc, and the active solution bisulphate of mercury. Besides this the battery contains an induction coil and vibrator, the connections being brought out to the sides as shown. By the insertion of the metal tips in the proper holes, either the self-induced primary current, the secondary current, or both combined, can be obtained from the coil. One, two or three cells can be used at will, which, together with the graduator, permit of a large range of effects. This compact cell is manufactured by Mr. Henry Schwindt, of this city.



FIGS. 1 AND 2.—THE ZIPERNOWSKI VERTICAL RAIL ELECTRIC RAILWAY.

The Zipernowski Vertical Rail Electric Tramway.

Although tramways have come into universal use in cities, the presence of the tracks on the streets is still, by not a few, looked upon as an obstruction to traffic. To remove this final objection, Herr Zipernowski proposes a plan by which the rails shall be placed as close together as possible, so as to approximate the slit in a conduit system.

The execution of this principle is shown in the engravings, Figs. 1 and 2, taken from the London *Electrical Review*. The body of the car *K*, with its framework *R*, rests by means of the cross-bearer *T*, upon the running wheels, *L L'*, which are fixed obliquely, converging downward in order to transfer the horizontal pressure (arising from unsymmetrical loading, and from oscillations of the car) to the double rail, *S S*.

From the frame of the car the strong arms *A* extend through the slit *Z* down into the channel *N*. These arms, which are firmly fixed to the frame, support at their lower end guide wheels, or rollers *F*, which rest against the side rails *E E'*, and thus keep the car upright. If, for example, the load on the right side of the car is greater the wheels on the left side will press against the left rail, and conversely.

Both the main rails *S S* and the guide rails *E E'* rest on sleepers *B*, which are laid in the earth at suitable intervals. Between these sleepers the channel is made in a suitable manner, for instance, of bricks, coated with cement.

The line thus described differs therefore in its outward construction very decidedly from the common lines with horizontal rails, since in the former there is only one line of rails on the level of the street, while the second rail lies beneath in the channel above described. The plane connecting these two rails is vertical, whence this system is called a tram line with a vertical track. The channel, or conduit, also contain the electric conductors.

The Programme for the February Convention.

Secretary Garratt, of the National Electric Light Association, has just issued a bulletin giving a variety of information as to the work to be done at the convention to be held at Kansas City, on Feb. 11, 12, 13 and 14, 1890, at the Coates Opera House. The papers are as follows:

Mayor Davenport will welcome the association and attending visitors to Kansas City.

President E. R. Weeks will open the convention with a brief address.

Secretary and Treasurer Allan V. Garratt will make the usual reports.

Prof. Elihu Thomson. Subject not yet announced.

Prof. Henry A. Rowland. Subject not yet announced.

Prof. Rowland has very kindly consented to present a paper based upon a correspondence with the members of the association, now being carried on by the secretary, for the purpose of ascertaining with what technical questions connected with the art of electric lighting they find the greatest difficulty.

Mr. Thomas A. Edison will give an address—the subject of which is not yet announced—by phonograph, which will reproduce Mr. Edison's voice loud enough to be heard in all parts of the house. As but few persons have ever heard Mr. Edison speak in public, this address from the phonograph will be of unusual interest.

Mr. Frank J. Sprague. Subject: "Electricity as Applied to Street Railways."

Mr. F. E. Sickels. Subject: "The History and Theory of the Steam Engine."

Mr, George H. Babcock. Subject: "The Economic Generation of Steam."

Mr. Myron D. Law. Subject: "Nine Years with the Arc Lamp."

Mr. C. A. Harber. Subject: "Line Insulation from the Standpoint of Practical Experience."

Mr. T. Carpenter Smith. Subject: "A Universal System of Central Station Accounts."

Mr. A. J. De Camp. Subject: "The Cost of the Products of Central Stations."

Mr. C. J. H. Woodbury. Subject: "Central Station Construction."

Mr. C. J. Field. Subject: "A Recent Edison Central Station and the Results Thus Far Obtained."

Mr. Henry W. Pope. Subject: "How our Paths may be Paths of Peace."

Mr. C. C. Haskins. Subject: "Prodigality in Economy."

Mr. E. F. Peck, in the discussion of Mr. M. D. Law's paper, will give the results of his numerous tests of arc light carbons.

Papers from several other prominent gentlemen are looked for and will be announced later.

Reports will be made by the Executive Committee, Mr. G. W. Hart, chairman.

Committee on Patent Legislation, Mr. Arthur Steuart, chairman.

Committee on Underground Conduits and Conductors, E. T. Lynch. Jr,, chairman.

Committee on Harmonizing Electric Light and Insurance Interests, Mr. P. H. Alexander, chairman.

Committee to confer with Mayor Grant in regard to the International Exposition of 1892, Dr. Otto A. Moses, chairman.

Committee on Electrical Data, Mr. A. R. Foote, chairman.

Committee to memorialize Congress on the Abolition of Custom Duty on Copper, Mr. C. A. Brown, chairman.

Committee on Electrical Execution, Mr. E. W. Maher, chairman.

Committee on Standardization of Potential on Electrical Street Railways, Mr. E. T. Lynch, Jr., chairman.

National Committee on State and Municipal Legislation, Mr. A. R. Foote, chairman.

Electric Lighting in Mexico.—Mr. Theo. Plate, president of the Interstate Gas and Water Works Company, of St. Louis, has recently secured franchises, extending over long terms of years, for erecting and operating incandescent electric light plants in the cities of Durango and Aguas Calientes, Old Mexico. In both cases the franchises are accompanied with contracts for lighting the streets and other public places. In Durango the authorities use 200 32 c. p. lights and 150 16 c. p. lights, and at Aguas Calientes 150 32 c. p. lights and 175 16 c. p. lights. These lights are to be operated in the neighborhood of 240 hours per month. The Heisler system of long-distance incandescent lighting has been adopted for these plants, and orders have been placed with the St. Louis office of the company for complete outfits of central station apparatus. The plants will be models in every way, and on account of the high cost of fuel compound condensing engines of the high-speed type will be used. It is expected that this apparatus will be ready for shipment about Jan. 1, as the plants are to be in operation in time for the annual feasts which take place early in the spring. Mr. Plate and his engineer, Mr. Andrews, left for Mexico on the evening of the 21st inst, to begin active operations.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
107-177 Times Building, New York, Nov. 20, 1889.

The New Century Electric Company, of 21, 23, 25 Bethune street, has issued a neat little pamphlet, giving details, etc., as to its motor, recently illustrated in The Electrical World.

The McDougall-Martin Electric Company have taken offices in the *Times* Building. Mr. McDougall was late with the Daft Electric Light Company and previously Superintendent of the Edison Machine Works. They will make power business a specialty.

E. E. Garvin & Co., Laight and Canal streets, have transfered all their right, title and interest in the concern to the Garvin Machine Company, which assumes all accounts due to or by the firm. The notice of the change is signed by E. E. Garvin, G. K. Garvin and F. W. Garvin.

The Accumulator & Motor Company, of 17-19 Broadway, this city, has issued a pamphlet and circular calling attention to its motion filed on November 9 for an injunction against the Electrical Accumulator Company for infringement of patents assigned by C. A. Faure, on storage batteries.

Seeking the Right to Cut Wires.—New York City's appeal from Judge Andrews' decision enjoining the cutting of electric light wires was advanced last week on the calendar of the General Term of the Supreme Court, and the hearing was set down for Dec. 2. The appeal will be argued before Judges Van Brunt, Barrett and Bartlett.

The Loomis System.—Mr. Martin D. Van Buren and Mr. E. Heaton, on behalf of the Eureka Electric Company, have just put a Loomis incandescent plant in Couturat Bros. West New York Silk Mills, New Jersey, making the third silk mill in the State fitted up satisfactorily with that system, the plans all being furnished by Mr. E. Z. Southard, superintendent.

New York City.—The 3,000-light alternating current dynamo, which the Westinghouse Electric Company had on exhibition before the delegates of the Pan-American Congress in Pittsburgh, has been purchased by the Safety Electric Light and Power Company, of New York City. The dynamo was shipped directly from the exhibition to its destination in New York.

The Anglo-American Electric Light Manufacturing Company, of the Times Building, have issued a nice little pamphlet containing a number of testimonials as to the value and usefulness of the Sorley storage battery made by them. The results obtained, as here reported, go to show that the battery has a superior durability and capacity for abnormal output.

The Newark Machine Tool Works, East Newark, N. J., have issued a neat illustrated pamphlet of their new horizontal drilling and boring machines, of the kind recently described in The Electrical World. These machines are extremely useful for electrical factories, for work on dynamos and motors, where holes have to be drilled and bored parallel to plane surfaces or to other holes.

The Litofuge Manufacturing Company, 53 Cedar street, this city, have a boiler cleansing and preserving compound which is making its way into very general use. It it a fine brown vegetable powder, easily applied and of prompt efficacy. Mr. F. Blanc, who is actively connected with the company, is also agent for the drop-feed oil cups of Et. Verny, of France, these cups being well known and in high repute all over Europe.

Fine Machine Tools.—Among the tools ordered for the Watervliet Arsenal at West Troy, N. Y., Gould & Eberhardt, of Newark, N. J., have received contracts for four of Eberhardt's patent drill presses, also one automatic gear-cutting machine with rack-cutting attachment. Orders for the above tools are being duplicated by those who have adopted them. Although not lowest in price among nineteen bidders of the leading representative tool builders of the country, the above tools were selected, which speaks for their merit.

The Telephone in Brazil.—The Tropical American Telephone Company say that the Bell patent holds the same position in Brazil under the Supreme Court decision that it does in the United States of America. An exclusive concession is operated under in Venezuela, and sub-companies are established in Barbados, Trinidad, Antigua, St. Kitts, Jamaica, San Domingo, Bermuda, as well as in the U. S. of Colombia, Venezuela, Guatemala, Costa Rica, all of which are under contract to buy from the Tropical Company, 18 Cortlandt street, New York.

The Jordan-Mills Manufacturing Company, 18 Cortlandt street, report that the sand box recently illustrated in The Electrical World has already gone into use on several hundred cars, and that it is largely employed on electric roads. Among the large orders last week was one from Brill of Philadelphia. This sand box is a really valuable appliance, and it has the additional merit that it can be put under a car without any cutting of the car body, being complete in itself. The pressure of the driver's foot regulates the amount of sand that flows.

Mr. George W. Hunt, expert draughtsman on mechanical and electrical engineering, with advanced modern ideas on architectural designing, is making his headquarters at 233 Hancock street, Brooklyn, where he will be pleased to receive propositions. Mr. Hunt planned some of the work on the New York Aqueduct; his plans for the Quaker Bridge Dam are acknowledged to be one of the best pieces of mechanical engineering. Mr. Church, the chief engineer of the aqueduct, speaks in the higest terms of his ability. He also has a letter from Mr. J. H. Vail, former chief engineer of Edison Electric Light Company, acknowledging his ability as shown in work that can be seen in some of the finest Edison stations.

Presentations in Brooklyn.—Mr. C. J. Field, the manager of the Brooklyn Edison Electric Illuminating Co., was presented on the evening of the 20th with a unique watch charm by the foremen of the company as a token of their high esteem. It is about the size of a 50-cent piece. On one side is the inscription, and upon the other is a miniature Edison lamp with a coil of wire attached. A lunch followed. On Nov. 23 the wiremen of the company presented Mr. H. H. Pollard, the superintendent, with a beautiful watch chain and locket, with a suitable inscription. Speeches were made by Messrs. Field, Miers, Way, Draper, E. L. Pollard, and others. Mr. Pollard acknowledged the testimonial in a neat and happy manner. Mr. Field has since been presented with a Mexican onyx clock, two handsome vases, and a set of silver cutlery.

Mr. Eugene T. Lynch, Jr., has secured the contract for the lighting of the town of Chatham, of this State. A company has been formed, and they expect to have the lights running within thirty days. They will use the Thomson-Houston or Westinghouse system. The city has closed a large municipal contract, and expect that a large number of private lines will also be used. The circuits will be run with first-class water-proof wire. He has also secured the contract for the lighting of the Johnson Manufacturing Company, North Adams, Mass. The plant will be equipped with new Corliss engine, several hundred incandescent lights and a 35-light, arc, dynamo. The building will be wired under the rules and regulations of the New England Electric Exchange.

The New York Safety Steam Power Company's engine is well known to many of your readers as one of the most reliable of the many high-speed engines in the market. The company is inclined to be conservative, and does not expatiate upon its daily doings very much—in fact, hides its light under a bushel to an extent which verges on error; but I find their engines in place in most of the important plants about town, and conclude that Mr. Copeland (the company's manager) has a good grip on the confidence and good will of the leading light companies. He has recently placed an engine of 150 h. p. (the third New York Safety) in the Edison Annex Station, No. 60 Liberty street, and has just closed the sale of two 150 h. p. Safety engines for the new Madison Square Garden.

The Fort Wayne Electric Company now have orders on their books at their Brooklyn factory for their new Wood arc apparatus as follows: 510 arc lights for Cincinnati, O., Electric Light Company; 40 for Wyandotte, Mich., Electric Light Company; 40 for Media, Pa., Electric Light and Power Company; 60 for Paris Gas and Electric Light Company, Paris, Tex.; 180 for Electric Improvement Company, San Francisco, Cal.; 2,400 for Municipal Electric Light and Power Company, St. Louis, Mo.; 60 for Swift & Co. Kansas City, Mo.; 125 for Detroit, Mich., Electric Light and Power Company; 40 for James Dunham, South Bend, Ind.; 120 for Merchants' Electric Light Company, Philadelphia, Pa.; 100 for Greensburg, Ind., Gas Light Co.; 25 for the Allen Apartment Building, Chicago, Ill.

The River and Rail Electric Company are quietly pushing the interests of the storage and power apparatus invented by Prof. W. Main. The "R. & R." battery on the Fort Hamilton route of the Brooklyn City Railroad is a built-up Planté, one on the electrolytic process, and, it is claimed, yields a higher E. M. F. than the ordinary ones. There is no buckling and no deposit, and no injury from overdischarge. The car weighs 5,200 lbs , or with 56 cells of battery, motor, mechanical appliances, etc., about 9,500 pounds in all. The motor is set in a bed-plate of cast iron, and is called a "vortex" motor. It has a stationary armature and a revolving field; the field magnets carry no wire, the armature containing it all. Mr. G. C. Wright is president of the company; Mr. Albon P. Man, vice-president; Dr. T. F. Randolph, secretary and treasurer. Mr. W. Main is the electrician.

The Julien Cars Running.—Mr. William Bracken reports as follows in regard to the resumption of work by the Julien cars on Fourth Avenue:

"We take pleasure in informing you that we have resumed the electric car service on Fourth avenue, in this city, with new batteries made under the process awarded us by Judge Lacombe in his recent decision. We should be very glad to have you inspect these batteries, either at our station or on the car. You will find, we think, as we do, that they are superior in every way to those which we have hitherto manufactured. We find an extraordinary advance in the efficiency of these batteries over any others that we have ever used. We are more than surprised ourselves, and you, I think, will admit that it is an extraordinary result; that while the old batteries had a fall of potential of over 30 in a run of 12 miles the present batteries have a fall of potential of less than 10 in covering the same distance."

Storage Battery Litigation.—The case of the Electrical Accumulator Company against the Gibson Company was called before Judge Lacombe, in the U. S. Circuit Court for this district on Friday morning last, Mr. F. H. Betts stated to the court that the application for a preliminary injunction was based upon the first and second claims of the Faure patent, No. 252,002, for secondary batteries; also upon a patent issued to Sellon, No. 366,770, for a form of perforated plate, similar to that shown in Gibson patent, No. 342,594. Mr. Betts stated that having seen the affidavits of defendant in opposition, he did not ask for a preliminary injunction upon anything except the first claim of the Faure patent, as modified by the disclaimer in the case of the Electrical Accumulator Company vs. the Julien Company, decided by Judge Coxe some months ago, limiting the claim to the construction of plates in which the active material is applied in the form of a paint, paste or cement. Messrs. Grosvenor P. Lowrey and H. D. Donnelly represented the Gibson Company, and Mr. Lowrey replied that he was instructed by his clients not to oppose the allowance of the preliminary injunction under the first claim as limited by the disclaimer, the reasons for this course being that the claim had been already adjudicated, and also that he was informed that his clients did not longer apply the acting material in the manner described, and were now constructing their plates in strict conformity to the recent opinion of Judge Lacombe in the case of the Electrical Accumulator Company vs. the Harlem Railroad Company, and added that since they were making history in this subject of secondary batteries, he desired the court to take notice for future occasions of the fact that the motion was abandoned or withdrawn so far as it rests on the second claim of the Faure patent and on all the claims of the Sellon patent. With this understanding the court directed an injunction to issue without opposition.

W. T. H.

Buffalo, N. Y., Nov. 22, 1889.

The Edison Company have also just installed a 115-light incandescent plant for Messrs. Robinson & Doblers' planing mill, at Tonawanda.

Messrs. Wilson & Wilson, electrical contractors, of Tonawanda, N. Y., have just completed a 100-light incandescent installation for the Eastern Lumber Company of that place.

The Buffalo Association of Fire Underwriters recently adopted new rules and regulations governing the installation of electric light and power plants, which have just been issued in neat pamphlet form.

The Western Union Telegraph Company, in this city, have had two cabinet sets of long-distance telephones placed in their main office and the branch office at the New York Central Depot for the convenience of the public.

A Westinghouse Plant of 50 arc and 500 incandescent lights for the Albion Electric Light and Power Company, of Albion, N. Y., is in course of construction by the Marr Construction Company. Mr. W. L. Adams, of Buffalo, is the electrical engineer in charge of the work.

The Brush Company.—An agreement has been entered into between the Brush Electric Light Company, this city, and Mr. Adams, for the Marr Construction Company, by which the latter company are to do all the construction for the Buffalo Electric Light and Power Company.

The Marr Construction Company, of Pittsburgh, Pa., have recently opened an office in this city, with Mr. W. L. Adams as manager. This company have just completed a 350-light plant in the Federal Buildings, this city, and have in course of construction a 350-light installation for the Academy of Music.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.
BOSTON, Nov. 30, 1889.

Mr. H. B. Prindle is contributing to *Building* an interesting series of articles on "The Electric Motor for Domestic Purposes," such as running elevators, etc.

Springfield, Mass.—The United Electric Light Company, of Springfield, Mass., has increased its capital stock from $150,000 to $300,000, and the majority of the increase has already been taken up.

Windsor Locks, Conn.—This town will, in all probability, soon enjoy the felicity of electric lights, and an endeavor is being made to incorporate the Windsor Locks Electric Light and Power Company.

Hyde Park, Mass.—Considerable extensions will be made to the Hyde Park Electric Light Station, as it is intended to erect a new brick building 35 feet by 50 feet. A 200 h. p. compound engine, two 1,300-light dynamos and two 50 arc-light dynamos will be added.

The Thomson-Houston Electric Company reports the following sales of incandescent apparatus to local companies: Athens, Ga., 650 lights; Somerville, Mass., 650; Elizabeth, N. Y., 650; Tuscaloosa, Ala., 650; Sioux Falls, Dak., 75; Hastings, Minn., 300; Huntington, Pa., 650; Ottumwa Railway Electric and Steam Company, Ottumwa, Ia., 1,300.

Abington, Mass., is to have a new electric light company, to supply Abington, Rockland and North Abington. The capital stock will be $40,000, and 60 arcs and 1,300 incandescents will be put in. Among those interested are H. B. Pierce, C. N. Cobb, M. N. Arnold, E. P. Reed and others.

Taunton, Mass.—A meeting of the stockholders of the Taunton Electric Lighting Company was held this week, for the purpose of increasing the capital stock. Mr. P. H. Carr holds a controlling interst in the company and proposes to change the plant to East Taunton. A new company using the Thomson-Houston system will be formed.

Lynn, Mass.—By the recent disastrous fire in Lynn, the offices of the Western Union Company and the Postal Telegraph Company and the telephone exchange were completely destroyed. For some time the only communication that could be had with Lynn was over the private wire of the Thomson-Houston Electric Company, whose factory is about a mile distant from the seat of the fire.

Mr. J. R. Magee.—One of the best known and most popular men in the electric light business in Boston is Mr. J. R. Magee, the general manager of the Thomson-Houston isolated lighting department. One has but to look at the list of sales which are reported from time to time in this column to see how successful this department is, and, considering the comparatively short time which Mr. Magee has been connected with the electric business, it certainly speaks volumes for him as an able manager and a clever salesman. Mr. Magee has the good wishes of all in the business, and his bright cheerful and jovial manner has made him a host of friends among the electric men.

Arc-Lighting Apparatus.—The Thomson-Houston Electric Company reports the following sales of arc apparatus to local companies: Shenandoah, Pa., 50; Lebanon, Pa., 50; Atlanta, Ga., 50, Lima, O., 50; East River Company, New York, 90; Jeffersonville, Ind., 50; Huntington, Pa., 50; Jersey City, N. J., 200; Burlington Gaslight Company, Burlington, Ia.; 50; Columbus Electric Light and Power Company, Columbus, O., 100; Adrian Electric Light Works, Adrian, Mich., 45; Southside Electric Company, Chicago, Ill., 50; Springfield Electric Light and Power Company, Springfield, Ill., 50; Ionia Electric Company, Ionia, Mich., 30; Ottuma Railway Electric and Steam Company, Ottuma, Ia., 75.

New England Electric Supply Company, Bridgeport, Conn., have installed a 7½ h. p. motor for operating the Third street drawbridge at Wilmington, Del., with equipments similar to the bridge which they equipped in Bridgeport some time ago, and which has been working so successfully. The Edison current of 220 volts is used, and the bridge will be lighted from the same circuit, no matter in what position it is. The cables were supplied by the Cobb Vulcanite Company. The New England Electric Supply Company anticipate a large business in this class of work, and the company is now equipping two other bridges with similar machinery.

West End Street Railway Company.—The electric cars have now been running on the new line from the Tremont House to Grove Hall for about two weeks, and with perfect success. The West End Company is sparing no expense to make the construction work safe and sure, and, by an agreement with the Board of Fire Underwriters, will protect the trolley wires with iron wires, run directly above the trolley wire. The insulated pin which supports the trolley wire will be extended and the guard wire attached to it, and extra span wires will be used to prevent any chance of accident should one by any possible means break. The Park Square and Harvard Square line has now also been opened to the public, and the cars run on ten-minute schedule time.

A Shipload of Samson Carbons.—The steamship "Samaria" has safely reached the port of Boston, having just been able to clear the bar, so deeply was she laden down with Samson carbons. For a week or so Colonel Burnham has been unable to fill as promptly as usual his numerous orders for batteries, owing to the extreme difficulty in getting carbons, and the "Samaria" has indeed proved a "good Samaritan" to him, as it brings enough to satisfy the demand for a few weeks. Another cargo is expected shortly, so that consumers will be able to get prompt shipments now and henceforth. The run on these batteries has been unprecedented, but Colonel Burnham, in his usual prompt manner, has provided for all demands, however large.

Search-Light Practice.—The "Yorktown," the "Chicago" and the "Atlanta," of Admiral Walker's fleet, which are at present in Boston harbor, indulged in a very satisfactory search-light practice this week. Each vessel used both of its search lights of 23,000 c. p., and the buildings all over Boston, wherever in range, were illuminated with great ease. At times the vessels would concentrate the rays of all the lamps on one object, which would have the effect of making it stand out in bold relief. When directed at a ferryboat or tug it had the result of completely demoralizing the pilot. The display, as a whole, was successful and imposing, and demonstrated its efficiency for searching for an enemy's boats and torpedoes in midnight darkness.

The Thomson-Houston Factories.—When the Thomson-Houston Electric Company moved to Lynn seven years ago it occupied one small factory. This soon proved inadequate to the needs of its rapidly increasing business, and new factories have been built until the plant has become the largest in the world devoted exclusively to the manufacture of electrical apparatus. The Thomson-Houston Company occupies at present eleven buildings, having a total floor space of more than six acres, and gives employment to 1,710 men and 300 women and boys. The capacity of its steam plant is 1,200 h. p. Each factory is equipped with all the modern machines for the rapid and accurate production of electrical apparatus for general lighting and power purposes, the quality of which is best shown by the fact of its general use.

Russell Electric Manufacturing Company, Providence.—This company has just completed the erection of 260 mast arms, which it has furnished to the Narragansett Electric Light Company, Providence. It has now about 16,000 feet of mast arms in use, and giving great satisfaction. Besides mast arms, this company keeps a large stock of ordinary street-lamp hoods and hard pine poles, which are generally square, with chamfered corners. They have now under consideration a contract for 250 mast arms, and have purchased material for about 5,000 feet. Mr. John I. Drake, the energetic manager of this company, secures for it also a good deal of outside construction work and repairs, and has just made application for patents on a branch box for incandescent circuits, which prevents the necessity of cutting the branch wires, as was necessary previously.

Isolated Plants.—The Thomson-Houston Electric Company reports the following sales of arc and incandescent apparatus for isolated plants: W. B. Durgin, Concord, N. H., 200 inc.; Springfield Foundry Company, Springfield, Mass., 200 inc.; Elkhorn Mining Company, Bowlder, Mont., 200 inc.; Putnam Nail Works, Neponset, Mass., 400 inc.; the Okonite Company, Passaic, N. J., 400 inc.; Pucanan & Lyall, Brooklyn, N. Y., 400 inc.; Standard Cordage Company, Boston, Mass., 400 inc.; F. A. Kennedy, Cambridge, Mass., 400 inc.; Dunn & McCarty, Auburn, N. Y., 400 inc.; Feister Printing Company, Chester, Pa., 20 arc; Kearney Paper Company, Kearney, Neb., 50 inc.; B. Nugent & Co., St. Louis, Mo., 35 arc.; Balatka Brothers, Chicago, Ill., 6 arc; Williams & Jarrems, Chicago, Ill., 35 arc.; Barnum & Richardson Manufacturing Company, Chicago, Ill., 6 arc; Armour & Co., Chicago, Ill., 70 arc; B. F. Draper, Ligonier, Ind., 30 arc; The Charles Block, Denver, Col., 800 inc.

The Standard Electric Time Company, New Haven, have just contracted with the Weed Sewing Machine Company, of Hartford, for a time plant of 18 clocks and 13 bells, to ring in different parts of the factory from the main regulator. The bells ring five minutes before seven, twelve, one and six o'clock, and work automatically. They have also supplied a school in Wilkesbarre, Pa., with 16 clocks and one regulator. Comstock, Cheney & Co., Ivoryton, Conn., have put in 15 clocks and bells; and a plant of 16 clocks, 12 bells and one regulator has been installed in the factory of the Strong Manufacturing Company, Winsted, Conn. This company is now making a special effort for factory trade, as at a very reasonable cost a factory can have one reliable clock and any number of electric dials all over the factory without the cost of separate clocks, and giving an absolute uniformity of time. The Electric Time Company has also just introduced a new switchboard for use with tower clocks, whereby dials can be placed in any part of the building and giving the same time as the tower clock.

National Telephone Manufacturing Company.—Mr. Bennett still continues to send out large quantities of his non-electric telephones, which are meeting with favor wherever they are introduced. Looking over Mr Bennett's order book, it is curious to note where these telephones go, some of them being used in the finest offices of large mills in New England, while others go to connect mines in the backwoods of some far Western State. Orders come from every State and are promptly filled. Among the most recent installations of the Bennett telephone may be noted the Lawrence Mills, at Lawrence, Mass., where eight telephones were used and where the work had to be done most particularly to conform to the elegant furnishings of the office. The Lamson Store Service Company have also adopted the Bennett system and contemplate using 18 telephones, while the United States Government have just ordered several for army quarters in a Western fort. The price of equipping a large factory with connections from its office to all parts of the factory, private houses, stables, etc., is so small that it is worthy of every mill owner's time to investigate these telephones.

Disastrous Fire in Boston.—One of the most disastrous fires which has occurred in the East for a number of years visited Boston this week. Several of the finest buildings, many of them quite new, have been completely demolished, and the damage is estimated at anywhere from $5,000,000 to $10,000,000. As usual in such fires the electric wires come in for a large share of the blame, and many of the critics bring a good deal of weighty evidence to bear out their opinions. One fact is sure, that a number of the electric time clocks throughout the city stopped at 7:48 A. M. on the morning of the fire, and on close examination the backs of the clocks were found to be fused. The central office of the Electric Time Company was situated in the Shoe and Leather Exchange, in which the fire originated. Though no one is ready to prove that the electric light wires were actually responsible, it is certain that a thorough examination will be made, with a view of defending all unreasonable statements. The Board of Fire Underwriters will doubtless take the matter up, and the probable outcome may be a general order to insert fuses on any wire which enters buildings, no matter how harmless in itself it may be. This plan has already been suggested, though never adopted to any large extent. Without doubt, many suggestions will now be made for the safety of electric wires, and a good opportunity is afforded for giving the subject an exhaustive discussion by numerous experts.

The Armington & Sims Company, Providence.—The Armington & Sims Engine Company early this month made some economy tests on the 100 h. p. double compound engine. The runs were of five hours each, condensing and non-condensing, and were made on the 1st and 2d of Nov. The engine has cylinders 10½ and 16½ inches in diameter, and 12-inch stroke. The speed on each trial was the same, 277 revolutions, and the initial steam pressure was the same both days, 110 pounds. Running condensing with Worthington independent condenser, the horse power developed was 102.17; the total water used in the five hours, 9,070 pounds; water used per hour, 1,814 pounds, or 17.75 pounds of water per horse power per hour. Running non-condensing on the 2d with the same conditions, the horse power developed was 77.02; total water used 9,461 pounds; water used per hour, 1,892 pounds, or 24.56 pounds of water per horse power per hour. The utmost care was used in preparing the company's complete testing room for the tests, and the results are very satisfactory to the builders. Some special engines for U. S. cruiser "Philadelphia" are now in the testing room. The cylinders of these naval engines are covered with a magnesia coating which the government prefers to asbestos, and cylinders and chests will be inclosed under one sheet of wood lagging, which has been substituted for the iron lagging strips. The little vertical, double, double-acting engine, especially designed at the request of the Navy Department for use where the space at disposal is very limited, takes up a width of 34 inches, length with dynamo, 70 inches, and height 52 inches. It has cylinders 5 inches diameter by 3 inches stroke, and its speed fully loaded is 800 revolutions. This engine has been thoroughly tested, and on removing instantly the whole load, the speed was increased but five revolutions, or a variation of but five-eighths of one per cent.

A. C. S.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 Mallers Building, Chicago, Nov. 30, 1889.

Mr. Frank B. Rae, the electrical railway engineer, of Detroit, dined at the club rooms this week.

Bedford, Ind., has awarded the contract to light her streets to the Thomson-Houston Electric Company.

Mr. J. H. Reid, general manager of the Western office of the Mather Electric Company, has gone East on a business trip.

Mr. Harry A. Kinney, of Omaha, is making a short stay in Chicago while perfecting arrangements for the handling of storage cells.

Mr. Ernst Hoefer, Chicago, secured orders last week for 15,000 pole steps and lag screws, and for 25,006 feet of No. 6 and 80,000 feet of other sizes of Bishop gutta-percha wire.

Mr. W. G. Halm, vice-president of the Perkins Electric Lamp Company, left Chicago on Monday's limited express to attend a directors' meeting in New York and to attend to other business.

The Henion Electric Signal Company has been formed at Wilmington, Ill., to manufacture electric railway signals. Capital stock $20,000; incorporators, William Henion, J. F. Johnson, F. R Mullin.

Mr. Ernest H. Heinrichs has an interesting story for young people in the Pittsburgh *Sunday Dispatch*, wherein he relates the adventures of two boys who paid a visit to the castle of "the Electric Wizard."

The Oshkosh (Wis.) Gas Light Company has filed a bill in equity wherein they charge two of the city aldermen with conspiring to defeat the plaintiff's attempt to secure the contract for the city lighting.

The New Brighton Electric Light and Power Company has been formed at New Brighton, Ill., to furnish light and power; capital stock, $20,000. Incorporators—P. W. Abt, M. Benzene, T. L. Fekate.

The Park Ridge Arc Light and Power Company has been incorporated at Chicago, to furnish light, power and water; capital stock, $50,000. Incorporators—F. B. Clark, M. T. Cahill, Edward Stack.

Guthrie, the new town in the Oklahoma country, that was only laid out last May, had a jollification on Saturday evening last over the illumination of the city with arc lights, and the principal buildings with incandescents.

Mr. F. M. Faber, late the electrical engineer of the Omaha Motor Company, dined at the club rooms on Friday last. Mr. Faber is now superintending the extension of the Sprague Electric Railway System at Canton, O.

The Kansas City & Blue Valley Railroad Company have secured a franchise from the County Court to construct an electric railway from the terminus of the 15th street cable line in Kansas City, Mo., to Centropolis.

The Thomson-Houston Electric Company employ in their Chicago office 37 men and five young ladies, not including the construction force reporting at these headquarters. This is a fair indication of the wonderful growth of their business.

Mr. Walter Kempt, of Chicago, made his maiden trip as an electric light sales agent last week, representing the Brush Electric Company, in a bitterly contested bid for a small town plant, with credit to himself and the great company he represents.

The Central Electric Company, Chicago, will remove to 116 and 118 Franklin street on Jan. 1. Mr. C. E. Brown, who has been representing the Central Electric Company on the road for some time, has become a stockholder in the company.

The Chicago Electric Club has filled the vacancies in the list of officers by electing Franklin G. Beach to the presidency and William H. McKinlock to the fourth vice-presidency. Twelve new applications for membership were favorably considered.

The Citizens' Gas Light and Heating Company, of Bloomington, Ill., has awarded a $30,000 contract to the Westing house Electric Light Company of Pittsburgh, to put in an electric plant, arc and incandescent, to be operated in connection with their gas plant.

The Germania Life Insurance Company's new building in St. Paul will contain an Edison plant of some 2,800 lamps, the Leonard & Izard Company, of Chicago, having secured the contract for the entire installation through their Northwestern representative, Mr. Arthur S. Huey.

The Marquette, Mich., Municipal Electric Plant was formally started on last Sunday, and 60 arc lights now illuminate the streets. The necessary power to operate the plant is said to be secured at Bend River Falls, 13 miles distant. Arc and incandescent lights are also supplied for commercial purposes.

St. Joseph, Mo.—The local papers make mention of the starting up of the New Excelsior plant, bought by the city. There are 173 lamps in position and 27 more are to be located. More will be wanted. The tower system is used. The station contains eight Excelsior dynamos and two Williams engines of 150 h. p. each.

Mr. Gustave Pfannkuche, of the Brush Electric Company, Cleveland, returned to Chicago from the West, en-route home, on Tuesday, being well satisfied with his trip, but disappointed in not arriving in this city in time to participate in the discussion following the reading of Mr. Jenney's excellent paper on high-tension currents.

Dr. Louis Bell, of Chicago, is becoming interested in the question of mutual armature insurance, referred to in this column some time since, and is gathering information, regarding the proper rates for risks, and would be glad to receive points from interested managers and superintendents of electric light, power and railway stations.

The Hillsdale, Mich., City Electric Light Company have purchased the Hillsdale Gas Works, and thus ended the disagreeable feature of rate cutting. The company is now operating 100 arc lights of the Thomson-Houston system and 650 incandescents of the Westinghouse system, in addition to the gas works. Both plants are now owned by the Stock family.

Mr. C. M. Barclay, of the Sprague Electric Railway and Motor Company, Chicago, has recently sold the following standard sizes of Sprague motors: One 15 h. p., one 10 h. p., two 5 h. p., two 3 h. p., two 1 h. p., and, in addition, has also sold to the Western Union Telegraph Company for use in their Chicago office two 15 h. p. and one 10 h. p. Sprague motors.

Mr. George Cutter, of Chicago, has just received a large stock of Simplex rubber wires of various sizes, also an extensive assortment of all the devices made by the Bernstein Electric Company, while in front of his warerooms hangs suspended a large Bernstein lamp connected in on the arc circuit, that proves an attractive sign, as it is lighted during the entire day.

The Electrician's Watch Company has been formed at Chicago to do a jewelry business; capital stock, $100,000; incorpor-

ators, D. A. Palmer, Joseph Harris, Homer Cook. This company proposes to supply watches of any make, jewelry, etc., to members of the electrical fraternity on the club plan, payments in instalments, or for spot cash, as may be desired, and at less than the usual rates.

Mr. Chas. H. Rusling, of Kansas City, stopped over a day in Chicago, en route East, with Mrs. Rusling, who will pass the winter at her home in Philadelphia. Among the late sales of Thomson-Houston apparatus made by Mr. Rusling have been 50 arc lights to Superior, Neb.; 30 arc lights to Camden, Ark.; 500 incandescents to Keith & Perry, Kansas City, and 650 alternating incandescents to Wichita, Kan.

The San Francisco Fire Alarm and Police Telegraph system is reported to be maintained in a high state of efficiency by Superintendent Samuel B. Rankin, who is allowed a salary of $2,400 per annum, and the following assistants: Operators, Wm. Morton, W. R. Hewitt and F. E. Haskell, at a salary of $1,500 each, a chief line-repairer, James Gorman, at $1,200, and the two assistants, W. Sweeney and Daniel Shay, at $1,080 each per annum.

Mr. Geo. C. Bailey has enlarged and fitted up his offices in elegant shape, making them about the lightest, most convenient and cozy offices to be found in Chicago. This increase was rendered necessary by the large business built up for the Jno. A. Roebling's Sons Company by Mr. Bailey during the three years he has been in Chicago. Mr. Bailey has been East, visiting both New York and the Roebling mills, on business connected with the company.

Merrill, Wis.—Four separate syndicates are competing for the franchise to build an electric street railway in Merrill, as follows: Harry W. Turner, of St. Paul, representing the Thomson-Houston system in which J. N. Cotter, David Finn and C. P. Larkin are interested; the Merrill Electric Lighting Company; P. B. Champagne, representing a syndicate, and a company from La Crosse At the last council meeting the clerk was authorized to advertise for bids.

Mr. Henry Walton Goode was married to Miss Edith Boothroyd Fairclough, Wednesday, at the residence of the bride's parents, No. 264 Huron street, Chicago. Mr. and Mrs. Goode left on an extended tour on the Pacific Coast. Mr. Goode is the well-known general district agent of the Westinghouse Electric Company, while Mrs. Goode's father is the genial M. T. Fairclough, who represents the Edison interests in Indiana and neighboring territory. The good wishes of all go with the happy couple.

The Electrical Supply Company, Chicago, have been almost flooded with orders during the week for their excellent "Shield" brand of water-proof wire. On Wednesday the mail and wires brought in orders for over 125 miles, and the aggregate amount of the week's sales will run up to nearly a thousand miles. The wisdom of the buyer in placing his order for wire at once, before a further rise in copper, is apparent, and there is good sense displayed in selecting an insulation of high quality.

The Ætna Machine Company.—The Ætna Machine Company, Warren, O., has closed a contract with Mr. Ralph J. Wick, treasurer of the Manchester Iron Company, for a 600 h. p. engine for their new plant at Lancaster, O. In July, 1888, the Ætna Company sold to the same gentleman a 500 h. p. engine for the Hubbard Iron Company, Hubbard, O. This being the second engine sold to the same party, it speaks well for the merits of the make. The engine sold in 1888 has been running night and day ever since it was placed in position.

The Knapp Electrical Works, Chicago, are crowded with orders for their celebrated Knapp needle annunciators, both for house and for hotel work. Some recent shipments contained cases of mahogany and of antique oak of exquisite design for use in private residences. Mr. Knapp makes a specialty of furnishing complete sets of annunciators and burglar alarms in cases of special design for any large supply house, and of furnishing a preferred pattern of case to a single house only, thus enabling that house to build up a trade in that particular line.

Mr. N. C. Stevens, of Toledo, contemplates resigning the position of manager of the Toledo Electric Company, and entering into the supply business in one of the larger cities. Mr. Stevens' knowledge of the actual requirements of light and power stations extends over many years' service at Toledo, Quincy, and other points, where he has made excellent records in the matter of placing on a paying basis stations that had become somewhat behind the times. Mr. Stevens will have the good wishes of all the "travelers," who have experienced his uniform kindness, and obtained many a good order from him.

The Magnetic Fire and Police Alarm Company, and the Instantaneous Fire Alarm Company, of Chicago, were incorporated last week, each with a capital stock of $500,000. The incorporators in each case were Milton Weston, N. W. Weston and R. H. Mason. Mr. Mason is said to be the inventor of the systems. Mr. Milton Weston is the present manager of the combined company and is also secretary of the Hoyt Frog & Crossing Company. His brother, N. W. Weston, is a railway contractor, both having offices at 239 La Salle street. They will not be ready to transact business before December 1.

Mr. S. W. Trawick, manager of the Chicago office of the Excelsior Electric Company, has sold 30 arc lights to the Queen City Electric Light Company, Gadsden, Ala., 30 arc lights to the village of Blue Island, Ill., and 30 arc lights to the Union Stock Yards Company, Chicago. The shafting and clutch pulleys for this last plant are to be furnished by the Hill Clutch Works of Cleveland, and the belting by the Chas. Munson Belting Company of Chicago. A 5 h. p. Excelsior motor has been sold to Mr. E. Smith, of Chicago, and a 3 h. p. Excelsior motor to the Charlotte, Mich., Electric Light Company.

The Charles Munson Belting Company, of Chicago, have shipped a couple of car loads of various sizes of Munson belting, together with all needed supplies, to New York, where they have opened up a branch warehouse at 34 Dey street, which will be under the management of their able Eastern representative, Mr. Emil Gabel, who has had a thorough and practical experience in all branches of the belting business. This movement will enable their Eastern customers to have orders filled from stock without delay, as competent and practical assistants have been detailed from the factory force to put the belts in such lengths as may be required.

William Baragwanath & Son, Chicago, report unusually large sales of the Baragwanath superheater and purifier, having received orders during the present month from every section of the country. Among the late shipments of superheaters and purifiers are, two of 500 h. p. each to Louisiana; two of 200 h. p. each to Colorado; one of 300 h. p. to Tennessee; one of 500 h. p. to Missouri. The shipments of Baragwanath boilers and purifiers thus far this month include one of 500 h. p. to Pennsylvania; one of 400 h. p. to Tennessee; one of 600 h. p. and two of 1,000 h. p. to Missouri; one of 500 h. p. to New Jersey; two of 1,000 h. p. to Ohio, and one of 1,000 h. p. to Michigan.

Mr. Franklin G. Beach, general superintendent of the Central Union Telephone Company, Chicago, was elected to the presidency of the Chicago Electric Club by its board of managers on last Monday evening. Mr. Beach is one of the charter members, and the club is to be congratulated on having secured so able an executive officer and one whose honorable record, and whose diligence and activity in the past give bright promise of good results in the near future, for all who are interested in the continued progress of the club as a source of definite and reliable information of value to workers in all branches of electric industry. Mr. Beach will have the hearty and loyal support of all the members.

William Baragwanath & Son, Chicago, have received some handsome specimens of a reddish deposit taken from the Baragwanath superheater and purifier in the works of the Chicago Brass Company at Kenosha. Seven hundred and twenty-one pounds of this deposit were removed after a run of seven weeks. A second lot of specimens of a rich chocolate color was received from Wood socket, Dakota, where 124 pounds was the total amount taken out of the Baragwanath superheater and purifier after a run of only eleven days. In the latter case but one quart of a slushy deposit was found in the entire boiler, and evaporation of the moisture left but a small quantity of a white powder. A more perfect example of the value of a purifier could scarcely be desired.

Mr. H. T. Russell, President of the Union Drop Forge Company, of Chicago, is placing an automatic oil burner on the market that was devised by himself, and has been in practical operation in his works for more than a year. The device is a simple one, and has effected a saving of over 40 per cent. in the fuel bills, Mr. Russell claims, with the further advantage of an entire absence of smoke. The oil is vaporized by exhaust steam before being fed to the furnace, and yields a steady, continuous, rolling flame of great intensity, accompanied by no roaring sound. Mr. Russell convinced the insurance companies of the perfect safety of the device, and is paying no higher rate than when burning coal. His main storage tank of iron is buried under ground, while the small tank holding the daily supply is placed just outside the engine room.

Mr. C. C. Warren, manager of the Leonard & Izard Company Chicago, reports that during the months of October and November they have secured contracts for the complete installation of Edison apparatus as follows, the figures given indicating actual dynamo capacity in 16 c. p. lamps: Isolated plants, one of 20 lights, two of 45, two of 80, three of 90, three of 100, three of 120, one of 135, one of 180, one of 200, one of 220, one of 270, two of 300, five of 450, two of 540, one of 600, one of 900, of 2,800 and one of 4,000 lights, while the increase in the capacity of isolated plants amounts to one of 100 lights, one of 120 and one of 180, making a total of 35 installations in isolated work alone, with a total dynamo capacity of 14,945 lamps. In addition to the above work, they have also installed three complete central stations, one of 750 lights, one of 900 and one of 1,500 lights, making a grand total of 18,095 lamp capacity. Their lamp sales have been unusually large, as have also their sales of supplies, the total of the latter approximating some $35,000 for the period named.

Mr. F. H. Soden, chief of the construction department of the Chicago office of the Thomson-Houston Electric Company, is constantly devising improvements that materially aid in reaching a higher degree of insulation, as, for instance, a porcelain insulator of regular size, but having an overlapping base of sufficient width to permit of the use of two screws, thus affording a stronger hold and allowing a greater strain on the wire than if only one screw were used in the centre. Mr. Soden has also brought out a glass lamp socket, designed for use in places where the ordinary metal parts are liable to be affected by fumes from acid tanks, or from the condensation of moisture, as in packing houses, etc.; and Mr. Soden is always ready with fruitful suggestions to aid any one who may be endeavoring to perfect some device that will permit of securing a higher degree of insulation. Judging from the help he has freely given to assist others in solving electrical problems, he must follow the precept of that quaint old writer, who said: "I expect to pass through this world but once. Any good thing that I can do, or any kindness I can show to any fellow human being, let me do it now."

A Desirable Plant.—Mr. Harry A. Kinney, of Omaha, who is in the city *en route* West from Cleveland, reports that the electrical plant which he installed at Tarkio, Mo., is giving perfect satisfaction to both the company and the consumers. Outlets for 600 lamps have already been wired, and some 400 lights are now in use. The current is supplied by an Edison dynamo that is operated from 5 P. M. till 11 P. M., when the steam plant is shut down and the dynamo cut out of circuit, and its place taken by a battery of 58 Pumpelly storage cells of 240 ampère hours each, previously charged while the dynamo was in operation. The cells supply all needed current until the next evening at 5, when the steam plant is again in operation. In other words, continuous service is furnished throughout the entire 24 hours, while the operating of the steam plant and its attendant expenses is limited to five hours. Mr. Kinney further states that the regular rate charged consumers is but one dollar per month per 16 c. p. lamp, with privilege of using the light whenever required No meters are employed except in the hotel and in one or two other large institutions. Considering the remarkably convenient service afforded, the rate charged appears unusually reasonable, and it is to be hoped that the utmost care will be observed in carrying out all the details of the system, slighting not even the smallest, in order that the plant may prove a commercial as well as a popular success, and thus pave the way for the introduction of the same methods of operation in other smaller towns.

F. De L.

ENGLISH NOTES.

[*From Our Own Correspondent*]

London, Nov. 6, 1889.

Gas in London Electric Light Conduits.—The misfortunes of even our best friends are cynically said to give us pleasure, and therefore it is quite possible that New York electrical engineers will hear with somewhat subdued sorrow that their confrères in London are already experiencing troubles due to gas leaking into the electric light conduits. A small disturbance took place a few days ago at Norfolk street, Strand, and subsequent to this there appears to have been a big explosion, in good New York fashion, at Albert Gate. This last explosion, however, is attributed by several daily papers to "the explosion of an electric battery," but I have no doubt from the accounts which have been published that the presence of gas in the conduits was the real origin of the disturbance.

Tanning by Electricity.—It is now just twelve months ago that the *Electrician* recorded in its columns the fact that a Swedish firm at Nordköping had successfully applied electricity to the process of tanning. Subsequently we heard a good deal about the process devised by MM. Worms & Balé, who it appears placed the rawhides in a revolving drum containing tanning liquor, to which was added a certain quantity of essence of turpentine, a strong electric current being then passed through the drum. It was claimed for this process that the time required for a complete tan was reduced from several months to a few days, and that the cost was reduced from 40 to 50 per cent. Within the last few weeks a rival process has been put before the public, which it would appear is the Swedish one referred to some twelve months ago. The inventor of this process is Mr. L. A. Groth, who places the raw hides on a light frame revolving in a circular vat filled with ordinary tanning liquor. It will thus be seen on the face of it, the two methods are not strikingly dissimilar. However, not being a practical tanner, I am unable to say what may be the merit of using a revolving drum as against a revolving frame, or what may not be the virtue of a slight addition of turpentine to the ordinary tanning liquor. We shall, however, in all probability shortly see the value of the patents, at any rate, determined by the usual process in the courts of law.

The Edinburgh Electrical Engineering Exhibition.—A few weeks ago I made note of the plans of the above exhibition. The executive have now secured a site of about ninety acres in extent, within easy walking distance of the centre of the city and possessing the very exceptional advantages of railway stations, belonging to the two great Scotch railway lines (the Caledonian and North British) within the grounds, thus enabling passengers from all parts of the kingdom to be set down within the exhibition inclosure. It is anticipated that the opening of the Forth Bridge (the greatest engineering work in the world) early in 1890 will attract numerous visitors, and these, added to the great stream of tourists, etc., which annually visit Edinburgh, will no doubt insure a success still greater than that achieved in 1886. The exhibition will include electrical engineering, general inventions, industries and fine arts. A great number of the most interesting exhibits now at Paris will be shown at Edinburgh, including samples of the extensive and unique collection of Mr. Edison, who also shows his interest in the exhibition as one of the vice-presidents. Exhibitors will appreciate the facilities which will be afforded them, probably for the first time in the history of exhibitions, of having their exhibits conveyed by rail direct within the exhibition grounds. The exhibition will be in two divisions, Division I. being devoted to electrical engineering and inventions, divided into six sections, comprising production of electricity, electrical conductors, measurements, applications of electricity, etc. American applications for space will, I understand, be received until Jan. 1. Intending exhibitors should, however, communicate at once, as the space is already largely applied for.

THE TELEGRAPH.

Asheville, N. C., will put in an electric fire-alarm system, and the Gamewell will probably be selected.

Goldsboro, N. C., wants a fire-alarm system, and Mr. N. O. Berry will furnish details as to the quantity of apparatus needed.

The Henion Electric Signal Company, of Wilmington, Ill., has been formed by W. Henion, J. F. Johnson, and F. R. Mullin, with a capital stock of $20,000.

The Excelsior Telegraph Company, of Smartsville, Cal., has been formed by W. J. Stewart, of Oakland; E. Wheaton, of San Francisco, and others, with a capital stock of $4,000.

Capt. Averina has been appointed director of telegraphs of the new Republic of Brazil. Communication has been provisionally suspended with all points in Brazil excepting the coast cities, which are served by the Western Brazilian Cable Company.

The New York Telegraph Club has been incorporated to exist in New York City with these objects: The promotion of healthful exercise and a closer relationship between members of the telegraph profession, and the giving of entertainments and maintaining of a club-house in New York City. The managers number 25 and are as follows: George W. Hann, Thomas W. Greene, Edwin Dean, John R. Powers, Edward E. Brannin, Edward F. Stevens, James E. Tompkins, Frank Griffiths, Frederick T. Meyer, Thomas J. Dunn, J. H. Lounsbery, F. R. Blanchard, Conrad A. Meyer, J. Clayton Watts, James I. Buxton, John Brant, Robert Morton, C. Frederick McCrum, Richard Kane, Harry J. Edson, E. V. Wedin, John H. Roloson, Edward W. Morrison, John B. Taltavall—all of New York.

THE TELEPHONE.

Chattanooga, Tenn.—About $15,000 has been spent in renovating the telephone exchange, putting in new switchboard, etc.,

Edgefield, S. C.—The Parkinsville, Modoc & Edgefield Telephone Company has been formed by W. R. Parks, W. E. Prescott and J. D. Holstein.

The Old Dominion Phonograph Company has been formed in Virginia, with J. H. Gilora, of Richmond, as president; L. L. Powell, secretary, and J. B. Levy, treasurer.

The Phonograph in Mexico.—Mr. Connery, the representative of Mr. Edison, has made a contract with the government for the establishment of a phonographic postal service. A large proportion of the Mexican people cannot read, so they are to be enabled to talk to their friends at a distance by means of the phonograms sent through the mails under government supervision.

Telephone Taxes.—The American Bell Telephone Company has won in the suit brought against it by the State of New York, the Court of Appeals reversing a judgment of $34,478.90 in favor of the State. The people claimed that for 1882 the capital employed in this State by the company was $999,600; that it increased steadily until, in 1886, $1,633,618 was the amount employed here; that the company was bound to pay as taxes for these years $34,478.90. The defense was that the company itself did not during these years do business within this State within the meaning of the statutes.

THE ELECTRIC LIGHT.

Superior, Neb.—Mr. R. Guthrie has secured an electric lighting franchise.

Rouse's Point, N. Y., is to have a local company, which will use water power.

Piedmont, W. Va.—The Piedmont Electric Light Company will enlarge its plant.

Little Rock, Ark.—The Little Rock Electric Light Company has enlarged its plant.

Ashland, Ky.—The Ashland Electric Light Company will put in an incandescent plant.

New Iberia, La.—An incandescent plant is to be put in the saw mill of Gall & Pharr.

Phœnixville, Pa., proposes to have a plant of its own to be located at the water works.

Norfolk, Va.—Mr. H. L. Maynard and associates in a local company will put in an electric light plant.

Tarboro, N. C., will probably have an electric light plant, and the Mayor can furnish information about it.

Galveston, Tex.—W. F. Ladd wants to organize a company to manufacture a battery for electric lighting purposes.

Raton, N. M.—The Raton Electric Light Company has been incorporated by R. Mercy, M. A. McMartin and C. A. Fox.

Chattanooga, Tenn.—The Chattanooga Electric Light Company will issue $200,000 of bonds to meet the enlargement of its plant.

Eagle Pass, Tex.—A local company has been formed, with a capital stock of $25,000, and it has already made contracts for machinery.

Morganton, N. C., will probably put in an electric light plant, and correspondence on the subject may be addressed to N. B Dilworth.

The Rock Falls, Ill., Electric Company has been formed by A. C. Stanley, J. M. Bickford and B. F. Kadel, with a capital stock of $25,000.

Charleston, S. C.—The Charleston Electric Light and Power Company will enlarge its plant, putting in another engine, additional dynamos, etc.

Eureka Springs, Ark.—The Interstate Gas Company, of St. Louis, has been granted a franchise to erect an electric light plant. It owns the gas works.

The Universal Arc Lamp Company, of this city, has been formed by C. A. Noll, B. A. Devoe, A. D. Keyes and others, with a capital stock of $100,000.

Belton, Tex.—The Belton Light and Water Company are now ready for bids on a 10-light arc dynamo and lamps complete. Mr. C. B. Smith is the secretary.

St. Charles, Mo., is looking into the subject of electric lighting, and will decide whether to have a plant of its own or pay a contract price for city lights.

Ocean Grove, N. J.—The Ocean Grove Camp Meeting Association intends to increase its Heisler plant by putting in two more of the largest Heisler machines.

The Evanston, Ill., Electric Illuminating Company has been duly formed by C. E. Byrne, L. L. Smith and E. F. Abbott, with a capital stock of $50,000.

Winooski, Vt.—The local Thomson-Houston Electric Company will put in a 200 h. p. engine for use during the winter, while the water power plant is being overhauled.

New York Lighting.—The New York *Commercial Advertiser* advocates the purchase and operation by the city of an electric light plant, and cites Chicago as an instance of what can be done.

Martinsburg, W. Va.—The Martinsburg Electric Illuminating Company has been organized by C. J. Faulkner, S. W. Walker and H. C. Berry with a capital stock of $50,000. The Edison system will be used.

Weston, W. Va.—The Weston Electric Light and Power Company has been formed by J. S. Lewis, E. Ralston and W. G. Bennett, with a capital stock of $100,000. The plant will comprise 20 arcs and 300 incandescents.

Connellsville, Pa.—The Connellsville Electric Company has been organized with a capital stock of $30,000. John D. Frisbee is president, John L. Gans, secretary and superintendent, and E. T. Norton, treasurer.

Westinghouse Dividends.—The Westinghouse Electric Company and the Westinghouse Electric Manufacturing Company have declared dividends of 1½ per cent. for the quarter to Sept. 30 upon stock of Nov. 18.

The Atwood Electric Company, of East St. Louis, has been formed by L. C. Atwood, E. R. Roth and C. C. Beaver, with a capital stock of $500,000. It proposes to make a new electric headlight, the invention of Mr. Atwood.

New Cumberland, W. Va.—The New Cumberland Light, Heat and Power Company, lately mentioned as organized, is erecting an incandescent plant of 750 lights capacity, and will add an arc plant as soon as a contract can be made with the city.

The Marr Construction Company, of Pittsburgh, have published a folder, giving a long list of central stations and isolated plants put in by them, as well as buildings that they have wired. They have no fewer than 74 central stations to their credit.

Running Overtime.—A notice has been put up in the various departments of the Westinghouse Electric Company's works in Pittsburgh to the effect that the works have to run overtime three nights every week on account of the great pressure of orders.

New Iberia, La.—The New Iberia Electric Light and Power Company has been formed with a capital stock of $10,000. A 600-light dynamo will be put in at a saw mill. Mr. J. A. Breaux is president; Mr. W. Robertson, vice-president, and Mr. W. M. Gates, secretary.

The Heisler System of long-distance incandescent lighting has again been honored. This time the distinction comes from the Texas State Fair and Dallas Exposition, where it received first premiums for the best system of incandescent lighting and the best incandescent dynamo and regulator.

Des Moines, Ia.—The Des Moines Water Power Company has been formed to utilize local water power in the generation of electricity, and it is proposed to pay special attention to electric motor work. The water plant will be supplemented by reserve engines. Mr. C. K. Mead, the secretary and manager, has been for seven years the efficient manager of the local telephone exchange.

Springfield, Mass.—The stockholders of the United Electric Lighting Company, Springfield, Mass., have voted to increase the stock from $150,000 to $300,000, to meet the expenses incurred in enlarging the plant and carrying out the contract with the city. About 1,200 of the 1,500 shares were subscribed for on the spot, and the directors are authorized to sell all that is not taken by Dec. 15.

Brooklyn, N. Y.—Another pleader for permission to string electric light wires in Brooklyn has appeared before the Board of Aldermen, in the person of Mr. George D. Allen, of Allen & Co. His petition was referred to the Lamps and Gas Committee. Similar petitions from other concerns desirous of competing with the Citizens' Electric Illuminating Company have been before the committee for over two years.

The Heisler Electric Light Company, of St. Louis, announce that they have decided to change their standard lamps from 30 to 32 c. p., and from 15 to 16 c. p.; thus falling in line with other manufacturers in this respect. They have found themselves frequently at some disadvantage where specifications stipulate the 16 and 32 c. p. lamps. They will adhere, however, to their faith in the larger lamps, and will use the 32 c. p. lamp as their standard.

The Chicago Gas Trust.—The Supreme Court of Illinois, on appeal, has declared against the validity of the Chicago Gas Trust. No attack is made on the validity of the Trust Company as a corporation, or upon its right to make and sell electricity and gas, but it is denied that the Trust has any right to purchase and control as a monopoly the stocks of the other local gas companies. This "is not only opposed to the public policy of the State, but is in contravention of the spirit if not the letter of the constitution."

Rochester, N. Y.—Mr. Barnes, superintendent of the city fire alarm, has been doing good work in the removal of dead wires belonging to the city, the telephone service and the district messenger system. The Brush Company have 1,300 arcs, 600 incandescents and over 400 motors from one-eighth to 15 h. p., run on 27 different circuits, and have had no accident of any kind caused by electricity. The Rochester Company, with 500 arcs and 1,000 incan. descents, of the United States system, have been equally fortunate.

Hong Tai, a representative of the Canton Electric Light Company of Canton, China, has placed an order for several thousand dollars worth of "E. A." storage batteries with the Pacific Electrical Storage Company of San Francisco, a portion of the order being shipped on the steamer "Arabic," that left that port on the 9th ult. The Canton Company is reported to have a capital stock of $6,000,000, of which amount $400,000 has been paid in, and which will be used in installing Westinghouse plants in the Chinese provinces under a charter granted by the Emperor.

Facts About Kansas City.—Mr. T. F. Clohesey, the general manager of the Interstate Electric Company, has circulated a neat little pamplet of "Facts About Kansas City," in which it is shown that that city offers one of the most desirable places for an electric light convention. It has six electric light companies with 1,380 arc lights and 12,000 incandescents; it has several miles of electric railway; it is first in the number of calls per telephone; it is first in number of telephones in proportion to population; it is fifth in volume of telegraph business, and it is the centre of one of the finest and "livest" regions of the country.

Holden, Mo.—The City Council of Holden, Mo., has granted a franchise for electric lighting to Mr. Theo. Plate, president of the Holden Water Company. The franchise extends for a long term of years, and includes a contract for a number of 32 c. p. lights, to be burned until midnight on the moonlight schedule. The plant will be operated in connection with the water-works, the pumping station for which is located two miles east of the business part of the city. Orders for the necessary electrical apparatus have been placed with the Heisler Electric Light Company, of St. Louis, whose long-distance system will be used. It is intended to have the plant in operation by the middle of December.

The Hill Clutch Works, through their Eastern Manager, Mr. Walter C. Wonham, report that they have just closed a contract with the Norwich, Conn., Gas Light Company for the complete equipment of their new station with everything in the line of power transmission machinery and the "Hill" friction clutch pulleys and couplings. The plans for the station were designed by Mr. L. J. Hirt, M.E., of the Hill Clutch Works, and Mr. G. W. Phillips, Superintendent of the Norwich Gas Light Company. It is safe to say that, as the result of two such good heads working together, the Norwich Company will have a station, when finished, that will rank with the first among modern designs.

Wabash, Ind.—It will be remembered that the city of Wabash, Ind., was among the first to adopt the plan of lighting by arc lights on towers. This system was a few years ago displaced by the Heisler incandescent system, and the lights were distributed all over the city. For some time this plant was operated solely for public and domestic lighting, but a demand having sprung up for incandescent lights for commercial and domestic lighting, the company have decided to make considerable enlargements, and have placed their order with the Heisler Electric Light Company, of St. Louis, for one of their latest improved dynamos, having a capacity of 350 32 c. p. lights. The new plant will be in operation early in December.

Central America.—The number of central stations for alternating current incandescent plants in Central America, which the Westinghouse Electric Company has furnished with the necessary electrical machinery, is to be increased by two more. Negotiations with several parties from San Salvador, Central America, have just been concluded with the result of establishing central stations at Santa Anna, San Salvador, and Sansonate, San Salvador. The initiatory order calls for the machinery of a 500 light plant in each place, with the assured prospect of an early increase. One of the engineers from the staff of the Westinghouse Electric Company in Pittsburgh has already left for the South to superintend the work of making necessary arrangements for putting the plants into operation.

Carbondale, Pa.—The wisdom of investing money in the establishment of electric light plants is very strikingly illustrated in the following case in point: The Carbondale Light and Power Company, of Carbondale, Pa., was incorporated about three years ago, and a contract was given to the Westinghouse Electric Company for alternating current apparatus of a 1,000 incandescent light plant and 40 arc lights. Now the concern has ordered additional machinery for 750 incandescent lights from the Westinghouse Electric Company, and one of the Carbondale gentlemen states in a note accompanying the order: "We have been very successful in our venture. We have paid 17 per cent. interest to our stockholders from the time our company organized, and, besides that, we are in a position to pay for the dynamo to increase our capacity, cash on delivery, which we will do, as soon as you ship the machine."

APPLICATIONS OF POWER.

Oakland, Cal.—The electric railway franchise has been passed over the Mayor's veto.

Waukesha, Wis.—Fitch & Jarvis, of Louisville, Ky., have secured a franchise for an electric road.

Santa Clara, Cal.—Bishop & Co. have been awarded a franchise for an electric road, overhead system.

Bryson, N. C.—It is proposed to build an electric road from Bryson city to Franklin at a cost of $300,000.

The Lockport (N. Y.) Street Railway Company proposes to run an electric road to Glenwood Cemetery.

Matteawan, N. Y.—The company to build a line next spring, is looking into the subject of storage batteries.

Elgin, Ill.—The Payne Street line has been bought by the City Railway Company, and electricity will be adopted.

Lawrence, Mass.—The Washington Mills have contracted for a Thomson-Houston electric tramway, of three-foot gauge, for their mill yard.

Washington, D. C.—A favorite ride in Washington is one out on the Thomson Houston electric road to the new Roman Catholic University.

Baltimore, Md.—The Mayor has consented to sign the ordinance for the North Avenue Railway Company, which proposes to use electricity.

Lynchburg, Va.—The Lynchburg Street Railway Company has been granted an additional term of six months for putting in its electric power.

McKeesport, Pa., is to have an electric road 10 miles long, at a cost of $150,000. It will include Dravosburg, Reynoldton and Duquesne suburbs.

Dover and Great Falls, N. H., will be connected by an electric railroad, and work will be commenced early in the spring. The Electric Light and Power Company have started their new plant.

Salem, Ore.—The Sprague Company will put in an electric road from the city to the Penitentiary and the Insane Asylum. The contract was secured by Tobin & Schurz, the Sprague agents at Portland, Ore.

Newburyport, Mass.—It is reported that the Robinson-Foster Electric Motor Company, who are furnishing power in this city to several factories, will shut down. The local electric light company will in all probability supply the power hereafter.

The Metropolitan Street Railway Company, of Toronto, is putting in an electric road from that city to Eglinton, two and a half miles. As this may be considered an entering wedge for electric roads in the Dominion, the work has been put in charge of Mr. L. Everson Winslow, of the Thompson-Houston Company, who constructed the Bangor road and several other successful railways.

Motors in Philadelphia.—The Daft Electric Light Company are placing a large number of motors in Philadelphia to be supplied with power by the Electric Power Company, 1229 Leiper street. The Daft Company have also determined to place with each motor a Whittingham automatic switch, and the Automatic Switch Company of Baltimore have just shipped to Philadelphia a large quantity of these switches for this work.

Richmond, N. Y.—When the City Electric Railway property in Richmond, Va., which was mostly owned by Maurice B. Flynn, became entangled in litigation, it was thought that his widow would lose her interests, but the announcement was made last week that the papers giving her possession of the entire property have been signed by all the parties to the suits in which it became involved. The Sprague Company will now have a chance to put the road in good shape.

PERSONALS.

Postmaster-General Wanamaker has advocated a limited form of postal telegraphs in his annual report.

Prof. C. R. Cross has begun a series of fifteen lesson, for practical electricians, upon the "Generation of Electricity, Forms of Batteries and Dynamos," at the Wells Memorial Institute, Boston.

Count A. Zdzairski, a Russian government engineer, visited the Cowles Electric Smelting Works, at Lockport, on November 23. He is connected with the railroad building across Siberia to the Pacific Ocean, 4,000 miles long.

Dr. James B. Williams, of San Francisco, as the result of a long and painstaking investigation, has, it is stated, produced new insulating materials of great merit for wires and cables. A factory will be established by a company having its headquarters in New York.

Mr. C. E. Hoover, superintendent for nearly ten years of the Winchester, Va., Gas and Electric Light Company, where he has made himself a popular and valued officer, has resigned to accept a similar position with the Washington, Pa., Gas and Electric Light Company. He is succeeded by Mr. T. Monroe Snapp. Mr. Hoover has been presented with a handsome goldheaded ebony cane by his old firm.

Hon. James D. Reid, U. S. Consul to Dunfermline, Scotland, left on the German steamer "Lahn" for Southampton on Nov. 27. A large number of friends gathered at the Hoboken wharf to bid him farewell, and as the steamer passed Sandy Hook the signal station saluted him by lowering and raising the Stars and Stripes. Mr. and Mrs. Reid will proceed to London and thence to Scotland.

Mr. Herman Hellmich, the electrician of the Plant system of railways and steamships, has been entrusted with the installation of the electric light plant for the Grand Moorish Hotel, now in course of construction on Tampa Bay, Fla. The plant will be a large one, and the building will be, it is said, the grandest and most imposing steel and stone hotel on the American continent. The elegant finish of the hotel will not permit of any moldings or exposed wires.

President E. R. Weeks, of the National Electric Light Association, has been interviewed by the Kansas City papers as to the convention next February. It is evident that the greatest interest is taken in the subject locally, and that the city will greet the visitors with a very hearty hospitality. Mr. Weeks gave an outline of his programme, from which it is evident that the meeting will be by long odds the best the Association has ever held in the way of hard work and practical results.

Mr. M. J. Francisco, the well known president of the Rutlandt, Vt., Electric Light Company, has had his residence in that city equipped completely for electric lighting. The current is supplied from the station on the three-wire Edison system. The heating of the house is also controlled electrically. Mr. Francisco has also had the light placed in the barn, so that his horses are better lighted than the President of the Republic. Altogether, the installation is a very pretty and efficient one, and it is highly spoken of by the local press.

John Crerar, late a director in the Chicago Telephone Company, whose remains will lie in Greenwood Cemetery by the side of his mother—for he was a bachelor—has secured for himself loving remembrance through all ages by the wise and generous disposition made of his property, amounting to $3,500,000, in his last will and testament, the executors and trustees of which are Norman Williams and Huntington Wolcott Jackson, who are to be duly compensated, but are not required to give bonds, "as they have been true friends in life, so they will be when I am gone, and I intrust the management of my estate to their joint care." Though he be dead, yet shall his memory live forever.

MISCELLANEOUS NOTES.

Good-bye to the Board.—A bill is to be introduced in the next Legislature providing for the abolition of the New York Board of Electrical Control.

Lighting Horses.—A recent innovation is to place an incandescent lamp at the head of a horse, current being supplied from batteries in the vehicle he is hauling.

Lynn, Mass.—A writer, "S.," in the Lynn *Bee*, calls attention to the good effects, social, physical, etc., on the city and on its inhabitants of the employment of so many persons in the huge Thomson-Houston factories.

Electricity in Russia.—Our Moscow correspondent writes us that an American citizen, Mr. James Layton, representing an English company, has been granted permission to introduce electric lighting and electric brakes on the cars of the Nicholas railway.

Electrical Execution.—In spite of all talk to the contrary, there is no immediate likelihood of the infliction of death by electricity on Kemmler and McElvaine, for both of whom hanging is good enough. The apparatus has been got ready at Sing Sing, but the Court of Appeals has not yet declared the law valid and constitutional.

Maracaibo.—A new electric light plant has been successfully established at Maracaibo, in Venezuela, South America. The electrical work was done by James A. Scott, son of Superintendent Scott of the Gold and Stock Telegraph Company in this city. The installation was a success from the start.

Butterworth, Hall, Brown & Smith are a new law and patent firm, of 606 Eleventh street, Washington, and 25 and 26 Honoré Building, Chicago. It will also open offices in Cincinnati and New York. The personnel of the firm is strong, including as it does two ex-Commissioners of the Patent Office and one ex-Principal Examiner, who had charge of the Electrical Division.

Honors for Electricians.—In recognition of their valuable labors and merits in connection with the Paris Exposition, the following promotions and nominations to the French Legion of Honor have been made: *Commander*—M. Mascart; *Officers*—MM. Hippolyte Fontain, Gariel and Potier; *Chevaliers*—MM. Berthon, Cance, Desrozier, Jean Mouchel, Gustave Richard, G. E. Sautter, G. Sciama.

Death by Fire in Minneapolis.—The *Tribune* building, in Minneapolis, was destroyed by fire on Nov. 30, about 10:30 P. M. Among the killed was Mr. J. F. Igoe, the Associated Press operator, who held his post to the last, when he "broke" as the fire drove him from his key. He tried to escape to the street by holding on to the telegraph wires, but fell to the boiler roof, sustaining fatal injuries.

BUSINESS NOTICES.

Battery Cut-Out.—Attention is called to a simple device for disconnecting gas-lighting batteries if accidentally grounded. It is cheap, sensitive, never needs watching, and has no clockwork to be kept wound. Terms furnished by the Electric Supply Company, of Syracuse, N. Y.. No. 105 South Warren street.

The D. M. Steward Manufacturing Company, of Chattanooga, Tenn., report an ever-increasing demand for their patent lava insulation, and say that October was the largest month they had ever had. November, so far, equals October, and not the least trouble is experienced in marketing the product as fast as made.

The Sebastian-May Company, of Cincinnati, have just issued a new revised and enlarged catalogue of their well-known foot and power lathes, drill presses, machine supplies, etc., including a number of tools upon which they have expended much time and money in bringing them up to perfection. This catalogue should be in the hands of all electrical people needing the class of apparatus it relates to.

Houston's Electrical Dictionary is thus praised by the *Washington Post:* "No work of similar character has hitherto appeared that will begin to compare with this in completeness and accuracy. It is a volume of 650 pages, illustrated and compiled with the methodical carefulness and precision of a scientist who thoroughly understands what he is about. The book will be a great boon to electricians, and of valuable use to all interested in electrical progress."

Woodhouse & Rawson United, Limited, will now have their chief offices, warehouse and sample rooms at 30 Cannon street, London, and it is said that the show-room will be the most complete of its kind in England. The annual meeting of the company just held shows it to be in flourishing condition, and likely to report a marked improvement in the near future upon its already large business.

The Chalmers-Spence Company.—The exhibit of the Chalmers-Spence Company at the American Institute Fair, N. Y., this year was a decidedly interesting one. The company displayed a full line of their standard asbestos manufactures, including the popular fire-felt pipe and boiler covering made by them. A marine boiler covered with this material and a machine for making asbestos yarn, shown in operation, attracted considerable attention.

Lord's Boiler Compound is the subject of an interesting item in the *Stationary Engineer,* which speaks of the good work done by the boiler compound made by Mr. G. W. Lord, of Philadelphia, and deprecates the injustice done him by those who, by a similarity of name, etc., have sought to secure a share of the large business he has so successfully built up by merit and hard work, applying as he has done the latest discoveries in chemistry to the production and perfection of a scale solvent and corrosion preventive.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS ISSUED NOV. 19, 1889.

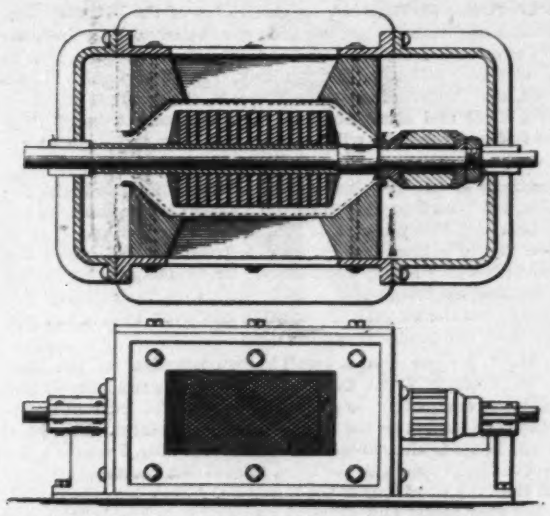
415,190. Dynamo Electric Machine; Thomas E. Daniels, Jr., of Provo City, Utah Terr. Application filed May 6, 1889. A dynamo or motor having a substantially rectangular frame composed of side, top and bottom plates, two field magnet cores bolted to the respective side plates, the cores and plates provided with openings which register with each other and admit air to the armature, the cores being recessed or dished.

415,262. Insulated Conductor; Jean A. Wetmore, of New York, N. Y. Application filed May 14, 1889. The combination, with an insulated conductor, of an enveloping sheath applied in the form of a ribbon having its edges united to form a longitudinal slack portion. See illustration.

145,274. Electro-Therapeutic Appliance; Harry H. Kane, of Boston, Mass. Application filed July 27, 1889. The device consists of a flat strip of hard rubber or equivalent coiled spirally and having alternately arranged on it positive and negative plates or equivalents connected by a fine conductor. It is preferably contained in a pocket textile materially by which moisture may be continuously provided to excite the plates and set up galvanic action.

415,327. Secondary Battery; Patrick Kennedy and Charles J. Diss, of Brooklyn, New York. Application filed Oct. 24, 1887. A storage battery plate constructed with cells, having fixing bottoms, the cell-forming partitions terminating in vertical lips adapted to be turned down over the top of the cells, the bottoms and the turned down lips forming the circulating openings.

415,329. Electrode for Secondary Batteries; Clement Payen, of Philadelphia, Pa., Assignor to the Electric Storage Battery Company, of Gloucester City, N. J. Application filed Feb. 13, 1888. The invention consists in fusing with a metallic salt a metal or metals or a salt or salts of such metal or metals or mixtures or combinations in variable proportions of two or more of them, then discharging the mass into a mold or other vessel to cause the crystals composing the mass in cooling rapidily or otherwise to assume a solid crystalized form in a structure, and then reducing the plate or other structure to a metallic state, and



NO. 415,190.—DYNAMO ELECTRIC MACHINE.

by the operation driving out matter foreign to the particular method required, whereby after washing will be produced a porous crystalized metal plate having substantial strength and especially adapted for use as an element of a secondary or storage battery.

415,331. Secondary Battery; Clement Payen, of Philadelphia, Pa., Assignor to the Electric Storage Battery Company, of Gloucester City, N. J. Application filed August 14, 1888. For description see page 368 this issue.

415,333. Insulator for Electric Batteries; Clement Payen, of Philadelphia, Pa., Assignor to the Electric Storage Battery Company, of Gloucester City, N. J. Application filed August 27, 1888. An insulating device, consisting of a horizontal tapering bar provided with recesses in the surface thereof, and vertical rods formed integral with the bar.

415,335. Incandescent Lamps; Jacob Reese, of Pittsburgh, Pa. Application filed Aug. 8, 1887. A twin incandescing lamp, consisting of separate chambers having a single common dividing wall, each chamber having openings at its opposite ends for the reception of the sealing plugs.

415,345. Electro-Medical Battery; Francis Moreton, of London, England. Application filed Dec. 3, 1888. Patented in England, Nov. 7, 1888. A galvanic or voltaic battery made up of a number of pairs of dissimilar metallic elements, each element being independently secured to a supporting frame or board so as to be readily removable therefrom, and having a strip or block of insulating material interposed between each pair of elements for the purpose of preventing metallic contact between the elements, as also to impart additional strength to the tongue pieces thereof.

415,350. Electric Motor; Harry B. Pullman, of Cambridge, Ohio, Assignor to the Woolly Electric Company, of same place. Application filed Aug. 10, 1889. In an electric motor an armature shaft having a diaphragm projecting to either side of its axial line and adapted to be dressed off or cut away at its longitudinal edges, so as to establish perfect equipoise of the armature shaft.

415,363. Armature Core for Dynamos and Motors; Frank F. Loomis, of Akron, Ohio. Application filed June 24, 1889. In a core for armatures for dynamo-electric machines, the combination of a cylinder having end collars, a central shaft, non-magnetic hubs mounted on the shaft, means, as screw thread nuts, to retain the hubs, and pins to unite the hubs and cylinder and support the latter.

415,417. Telegraph Repeater; Richard J. McIlhenny, of Wilmington, N. C. Application filed June 6, 1889. The invention has for its object to simplify the construction and operation of telegraphic repeaters so that any operator can attend to the same to prevent "kicks" in the instrument, and to provide a construction whereby the operator receiving when the repeater is repeating can break the sender, if desired, without rendering the line inoperative. A construction is also provided whereby the instrument may be switched off and used as an independent transmitter, when desired.

415,487. Automatic Electric Switch; George H. Whittingham, of Baltimore, Md., Assignor to the Automatic Electric Switch Company, of same place. Application filed Feb. 21, 1889. In an automatic switch, the combination of a main line which is divided into two branches, the branches reuniting again, an electric

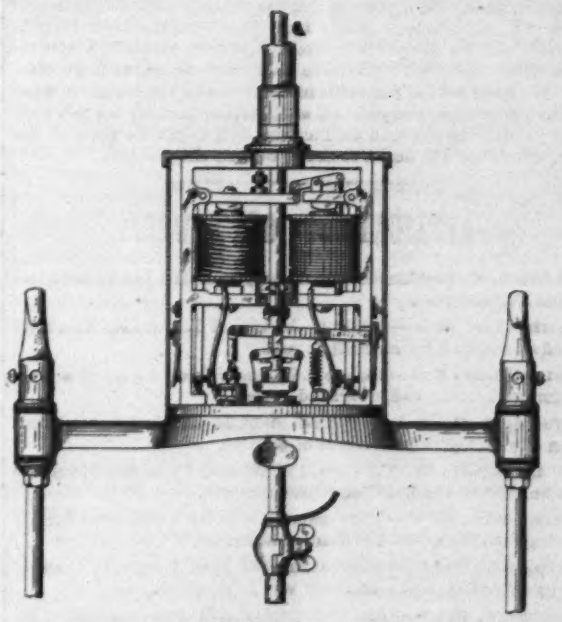
NO. 415,262.—INSULATED CONDUCTOR.

motor, the field of which is included in one branch and the armature in the other, resistance coils and a resistance bar co-operating therewith to cut portions of the resistance into or out of the circuit included in the armature branch of the main line, a governor connected to and controlling the motion of the resistance bar in the direction in which it reduces the resistance in the armature circuit, but allowing it to move freely in the opposite direction, and an electrical device controlled by the main line current for moving the resistance bar in the direction in which it will reduce the resistance in the armature circuit, and a spring or other equivalent device for moving the bar in the opposite direction.

415,490. Method of Constructing Electrodes for Secondary Batteries; William H. Allen, of Detroit, Mich. Application filed Aug. 15, 1889. The method of making electrodes for secondary batteries, consisting in forming the active material, or material to become active, into masses having interstices throughout, and then in running the base metal into the interstices in a molten state, and finally in cutting the blocks so formed into plates of suitable size.

415,491. Electric Meter; Peter Silvanus Bates, of York, Pa. Application filed Jan. 6, 1888. The invention consists in providing a series of contacts, one or more for each translating device, depending on its consumption of current, and in placing in operative relation thereto a shifting circuit closer controlled by clockwork or other mechanism, which will traverse the contacts in a definite interval of time, and actuated by an electrically controlled indicator which will be set to a new indication for each closure of the circuit.

415,504. Insulator; George Fowler, of Peckham, County of Surrey, England. Application filed Jan. 10, 1889. Patented in England, Jan. 30, 1889; in France, Dec. 28, 1888; in Belgium, Dec.



NO. 415,572.—ARC LAMP.

29, 1888; in Sweden, Dec. 29, 1888; in Norway, Jan. 24, 1889; in Germany, Jan. 10, 1889; in Spain, March 15, 1889; in Canada, March 19, 1889; in Italy, March 31, 1889, and India, April 24, 1889. A spring or springs arranged in such a manner that there shall be a continuous pull upon the conductor due to the action of the spring or springs, but in the event of contraction or an exceptional strain upon the conductor the insulator will yield so that the conductor will not be broken, and in the event of expansion or reduction in the strain upon the conductor the slack will be automatically taken up.

415,571. Arc Lamp; Charles E. Scribner, of Chicago, Ill. Assignor to the Western Electric Company, of same place Application filed December 31, 1883. The invention consists of a lamp having a stationary lifting-magnet in the main circuit, a feeding magnet in a shunt with the arc, and means whereby the feeding magnet may lower the carbon independent of any movement of the lifting armature.

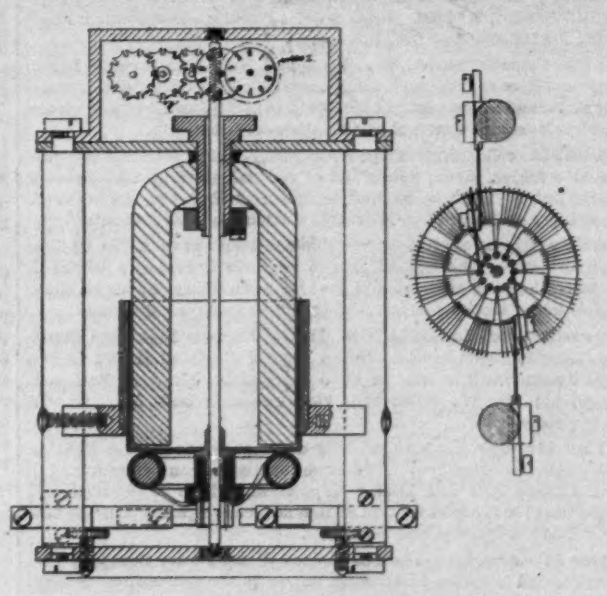
415,572. Arc Lamp; Charles E. Scribner, of Chicago, Ill. Assignor to the Western Electric Company, of same place. Application filed December 22, 1884. The combination, in a double carbon electric arc lamp, of a solenoid or electro-magnet and its armature, a clutch controlled by the armature, a rod supported by the clutch, and a contact point whereby the circuit may be closed and maintained through the electro-magnet or solenoid and the clutch held out of engagement with its rod. See illustration.

415,573. Telephone Exchange System; Charles F. Scribner, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed June 13, 1887. The combination, in a telephone exchange system, with the signaling circuit, including several stations and a telephone permanently connected in the signaling circuit at the central office, of individual telephone lines radiating to the different stations and an induction coil and switching apparatus at each station, whereby any subscriber can connect his telephone into a local circuit, including one of the windings of the induction coil, the other winding of the induction coil being included in the signaling circuit.

415,574. Electric Police Signal System; Charles E. Scribner, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed Aug. 3, 1887. The invention consists in a circuit extending from the central station through signal stations, a current reversing device in the circuit at the central station, including a telephone and condenser, with a polarized relay and key at each signal station in addition to the ordinary call-box, usually termed the "eleven call-box."

415,577. Electric Meter; Ernst Werner Siemens, of Berlin, Germany, Assignor to Siemens & Halske, of same place. Application filed Dec. 2, 1887. The invention consists in the use of a dynamo electric machine acting as a motor for a registering device and of a "damping" apparatus for retarding the motion thereof, whereby the current passing off the circuit is indicated in ampère hours, or such other unit as may be desired. See illustration.

415,578. Fire-Alarm Telegraph Repeater; Francis A. Skelton, of Newton, Mass. Application filed May 27, 1889. The combination of several main electric circuits, a circuit breaker in each main circuit, a shunt circuit, an electro-magnet in each of



NO. 415,577.—ELECTRIC METER.

said circuits and an armature therefor, a switch connected with the armature of each of the magnets in the main circuits by which this magnet may be cut out and the shunt circuit brought into the corresponding main circuit, and several circuit breakers, one for each of the main circuits, connected with the armature of the magnet in the shunt circuit.

415,593. Galvanic Battery; John Edward Watson, of Louisville, Ky. Application filed June 23, 1885. In a galvanic cell a depolarizing plate standing above and insulated from the zinc or positive metal and in metallic connection with the copper or negative metal, which is below, and insulated from the positive metal.

414,600. Secondary Battery; James A. Wotten and William R. Polk, Jr., of Atlanta, Ga., said Wotton Assignor to said Polk, Jr. Application filed Oct. 13, 1888. In a secondary battery, a storage plate having an interior chamber connecting with the exterior of the plate by apertures, beveled in such a manner that each perforation shall be larger at the inner and smaller at the outer end, in combination with a bolt carrying washers for holding the plate in a relative position with regard to the other plates.

415,629. Fire-Alarm Box; George L. Foote, of Brooklyn, Assignor to the Union Fire Alarm Company, of New York, N. Y. Application filed Jan. 30, 1888. In a fire-alarm box, the combination of a make and break wheel and motor therefor, a manipulating device for the motor, a controlling magnet permanently in the circuit, provided with a movable armature having retarding mechanism, and engaging devices interposed between the motor and manipulating device, and controlled by the armature, the parts being so arranged that when the armature is released its initial retraction releases the engagement between the motor and manipulating device.

415,641. Governor for Electric Motors; Charles L. Jaeger, of New York, N. Y. Application filed Aug. 20, 1889. The centrifugal governor acts directly upon the switch lever. The switch is also of special construction.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co. Ltd., Times Building, N. Y.